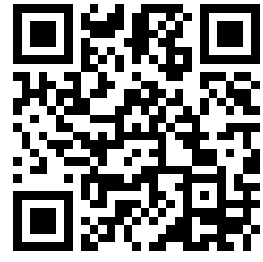


FM 24-1

Combat Communications

Purpose and Scope: **This manual sets forth the basic concepts of US Army tactical communications-electronics doctrine in a practical format. It is aimed at all personnel from the firstline supervisor to the highest echelon of command. This manual, along with the other "How to Fight" manuals, presents principles for winning the land battle—accomplishing the Army's primary mission.**

Users of this manual are encouraged to submit recommended changes or comments to improve its clarity or accuracy. Comments should be forwarded to the Commandant, US Army Signal School (ATTN: ATSN-TD-LIT), Fort Gordon, GA 30905. DA Form 2028 should be used for submitting comments, but comments will be accepted in any format.

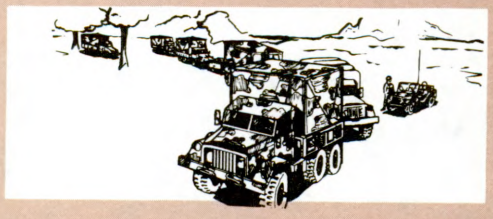
Field Manual
24-1

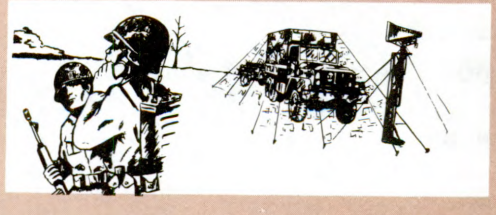
*FM 24-1

Headquarters
Department of the Army
Washington, D.C., 30 September 1976

Contents

*This manual supersedes FM 24-1, 8 April 1968, including all changes.





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CHAPTER 1

Chapter 1. Command and Control and Communications (C^3)

How important is the Electromagnetic Environment?

What are the US Army objectives?

What will the tactical environment be like?

How must we operate in the Electromagnetic Environment?

Command and Control and Communications (C^3)

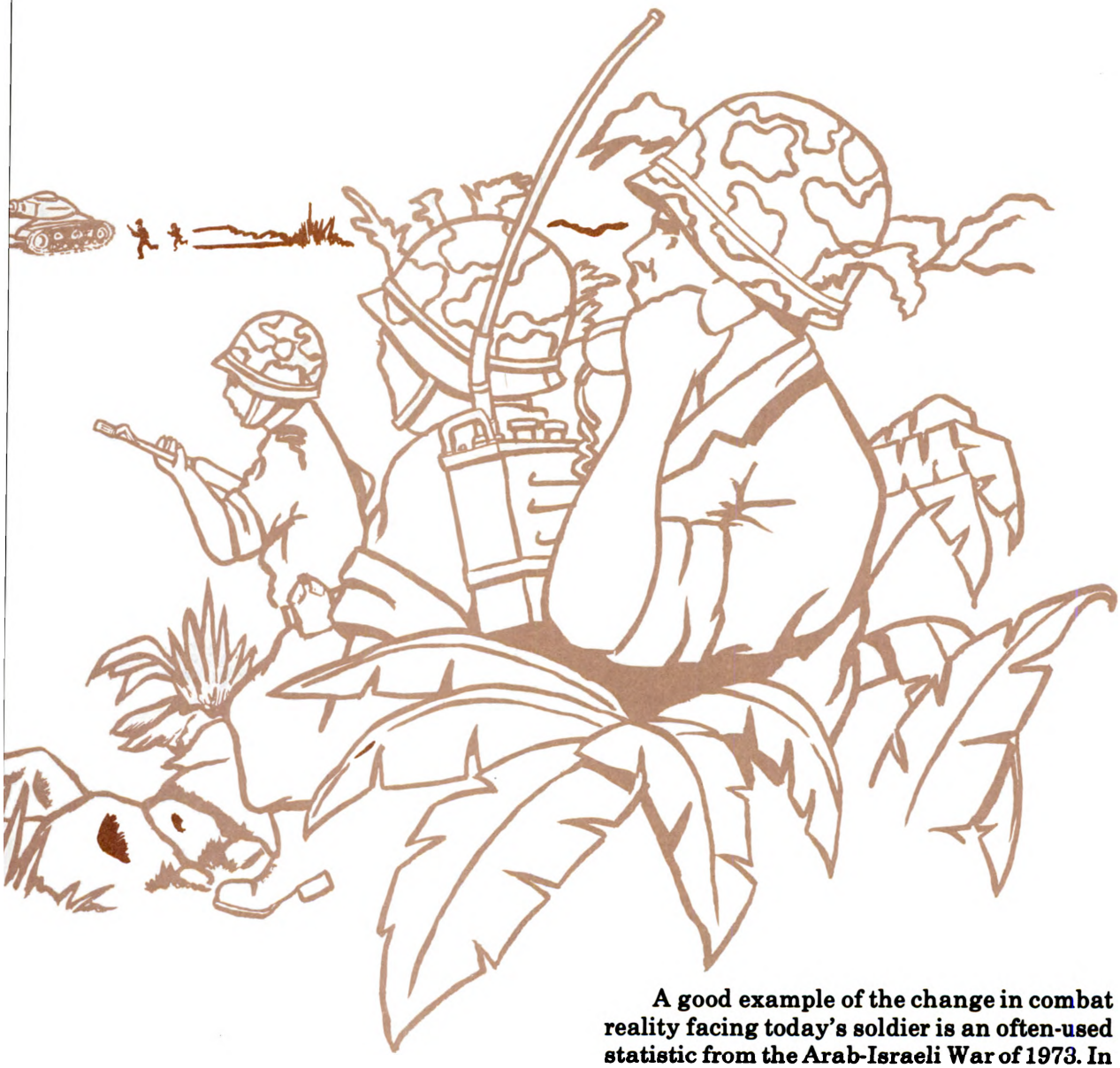
The US Army must win the first battle of the next war. PERIOD! For the Army to win, our soldiers must fight in the worst environment with the toughest objectives ever given a fighting force. They can expect to fight outnumbered at the opening stages of the fight. How are we going to accomplish the mission? This is where the "How to Fight" series of manuals comes into play. These manuals lay out the way the Army will win. This manual treats the communications that are necessary for command and control on the modern battlefield.

How Important is the Electromagnetic Environment?

Most of the manuals in the "How to Fight" series tell what must happen on the ground. For the Army, the width and depth of the battlefield are where it's happening. There are also "How to Fight" manuals that treat the airspace over the fight. Over the past few years, every soldier has come to realize how important the flying machine is to the fight. Yet, there is another environment on the modern battlefield which has been overlooked by many in the past. If the US Army doesn't carry out the better fight in this environment, we won't win. The environment we're talking about is the Electromagnetic Environment.

The Electromagnetic Environment is where the electronic emitters are working. The radios, radars, and laser beams, of both the enemy and our forces, share the same electromagnetic environment. When we communicate, the enemy is probably listening and gathering intelligence. Sometimes when we try to communicate, the enemy jams or tries to deceive us. If we overuse our radios, the enemy can apply direction finding and try to destroy us. When we try to use up-to-date radar to get a fix on the enemy, he can jam the radar and our weapons are ineffective. We must be aware of the enemy's efforts and be prepared to outperform him. The success of the fight in this electromagnetic environment could determine survival in the next war.

"Combat Communications" lays out the principles that the Army will apply to operate successfully in the battlefield's electromagnetic environment. If we use these principles, we can achieve the Command and Control and Communications (C^3) necessary to win.



A good example of the change in combat reality facing today's soldier is an often-used statistic from the Arab-Israeli War of 1973. In 20 days, over 1,700 tanks were destroyed between the two sides. That's as many tanks as there are in five US armored divisions. Technology has improved the weapons systems to the point where a tank has a 50-50 chance of being hit by the first round fired at it. We must retool our tactics to meet the reality of the next fight.

What are the US Army Objectives?

The US Army has arrived at a point where technology and reality have outrun our old tactics on fighting and left them in the dust. We've come to the shocking realization that the old way of doing things won't work any more.

The US Army objectives in the next conflict are to *win the first battle, win while outnumbered, and make the most effective use of powerful weapons and proficient personnel.*

● Win the first battle. -- This objective was the first thing mentioned in this book. Why is this objective so important? If you understand this, you're on your way to understanding the situation the Army must face in the next fight.

The Army must be prepared to fight if our freedom or the freedom of our allies is challenged by force. We cannot fall back on a drawn-out mobilization period to build up strength as we did in some past wars. We can no longer work under the idea that it's OK to lose the first battle as long as we win the war. In the next conflict, the first battle may be the whole war.

If we look carefully at the world today and look at the fighting that has taken place in recent years, we can see the premium that can be placed on winning the first battle. The fighting that flared up in the Middle East in 1967 and 1973 was fast and furious and short in duration. This is because weapons are more mobile and lethal but, at the same time, more emphasis has been placed on achieving a negotiated end to the fighting. The force that wins, or gains the most in the first battle, will be the side that can negotiate from a standpoint of strength. Of course, the mobility and lethality of the weapons on the battlefield might also spell a fast and complete defeat at the hands of an enemy force. If the US Army is in another fight, we've got to win the first battle, because there may not be a second chance.

● Win while outnumbered. -- The same careful look at the importance of the first battle will also telll us that we'll have to be ready to win while outnumbered. Let's look at an example. US Army and allied forces armored and mechanized divisions in Europe may have to defend against a formidable force. The threat forces have superior numbers in tanks, armored personnel carriers, artillery, as well as effective air support and air defense. So what do we do, faced with these circumstances? The smaller boxer can defeat the larger opponent by wearing him out and by making his best punches ineffective. Our forces, although smaller in number, must be able to fight better, wear the enemy down, and render his best assaults ineffective. This is how we can win while outnumbered. It's a lot easier said than done, but it can be done.

We can't afford mistakes on the battlefield which lead to costly losses. This means we must employ new tactics and equipment which make the most of an active defense of fire and maneuver and a carefully executed offense. This also means that the training a soldier receives must get him 100 percent ready to fight.

● Make the most effective use of weapons and men. -- To win on the modern battlefield, we must have capable leaders who employ our powerful weapons and proficient personnel to best effect. Because of increased mobility on the battlefield and the complexity of the fight, much more responsibility will rest on the individual commander. Again, the emphasis is on training to develop capable leaders and proficient personnel who can make the most of our weapons.

It's obvious that our forces can't be strong everywhere on the battlefield when they are outnumbered. Therefore, the key to winning will be carefully concentrating our forces at the critical points on the battlefield so we can achieve superior combat power there.

Win the first battle. Win while outnumbered. Make the most of weapons and men. These are the US Army's objectives, if and when there is another war.

What Will the Tactical Environment be Like?

We've looked at the objectives for the next fight, but what about the environment the soldier will be fighting in? This environment will be in sharp contrast to the battlefield the soldier of World War I found

six decades ago. The "Doughboy" found himself standing in mud for months in some trenches with the enemy 100 yards away in his trench. When the time came for an assault, our soldiers would be part of a daring charge to break the enemy's lines. On the modern battlefield, the key element is mobility. To win, our forces must concentrate superior combat power at the decisive time and place on the battlefield.

Since World War I, the tactical environment has changed drastically. Even the past few years have produced significant changes on the battlefield. Today's battlefield presents challenges beyond any the US Army has ever faced. Great numbers of very destructive weapons have been provided by major powers to client states. Arms purchased by minor but affluent nations have spread the latest military technology throughout the world. Recent wars between small nations have developed intensities formerly considered within the capabilities of large states only.

To win on the modern battlefield, four prerequisites must be met:

- ☐ Adequate forces and weapons must be concentrated at the critical times and places. The combination is combat power.
- ☐ The battle must be controlled and directed so that the maximum effect of fire and maneuver is concentrated at decisive locations.
- ☐ The battle must be fought using cover, concealment, suppression, and combined arms teamwork to maximize the effectiveness of our weapons and to minimize the effectiveness of enemy weapons.
- ☐ Our teams and crews must be trained up to the maximum capabilities of their weapons.

All these functions must be performed correctly at exactly the right time. If the functions are performed, and if the resulting combat power is skillfully applied by aggressive, confident leaders and cohesive units, then the enemy will be destroyed or defeated—the mission of the force will be accomplished.

In the division of responsibilities on the battlefield, it is the Generals commanding Corps and Divisions who must concentrate the forces. It is Colonels and Lieutenant Colonels of Brigades and Battalions who control and direct the battle. It is Captains and their Companies, Troops, and Batteries who fight the battle.

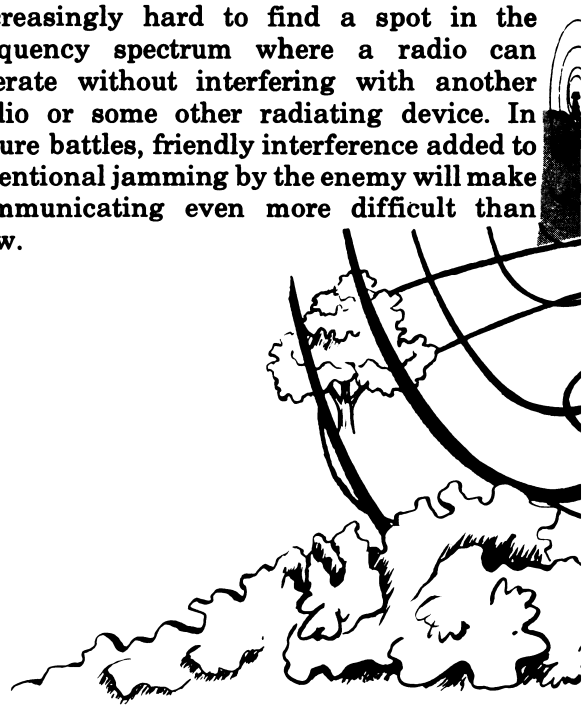
The prerequisites for success in battle cannot be met and the forces on the battlefield cannot be concentrated or directed without essential elements we'll be concentrating on in this chapter—*Command and Control and Communications.*

How Must We Operate in the Electromagnetic Environment?

We've talked about the complex scene on the battlefield, where our soldier is carrying on the fight. We've talked about the commander's ability to concentrate superior combat power at critical places and times in the battle as the key element in the fight. But, what ties the whole thing together? What makes the complex fighting machine work? The answer is Command and Control and Communications. Without responsive communications, you don't have command and control. This brings us into that very important electromagnetic environment.

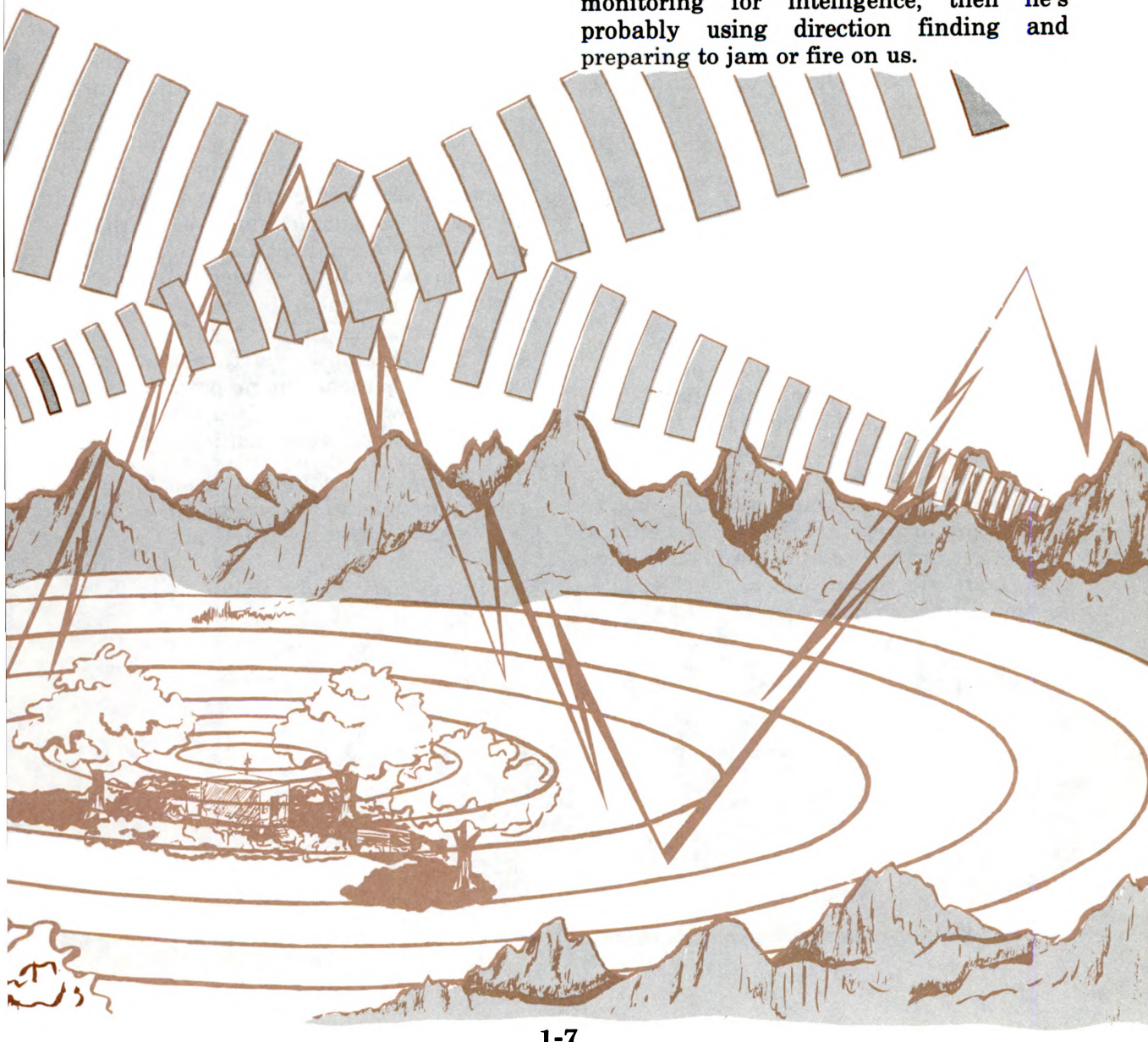
It's so easy to talk about moving troops around, to talk about calling in artillery and air support, without touching on the communications that have to be used. Communications have always been there, like the pay phone on the next street corner or in the next gas station as you're driving down the highway. In the next fight, everyone from the commander to the radio operator must grasp the importance of communications-electronics (C-E) and the great dangers that are present in the battlefield's electromagnetic environment. If we don't outperform the enemy there, we can't win.

What will be happening in the electromagnetic environment as the fight unfolds on the battlefield? The commanders on both sides will be trying to maintain command and control of their forces. The frequency spectrum will be crowded beyond belief. There are finite limits to the frequencies that are available. To get an idea of this environment, picture a US Army division operating in a 45 km by 30 km area with about 3,000 communications emitters working during the fight. Add to this the number of enemy emitters and sprinkle in noncommunications emitters, such as radar and laser beams. Now, you can start to see some of the problems. It's getting increasingly hard to find a spot in the frequency spectrum where a radio can operate without interfering with another radio or some other radiating device. In future battles, friendly interference added to intentional jamming by the enemy will make communicating even more difficult than now.



The enemy will be gathering intelligence while all this communicating is going on. He has special units with both airborne and ground-based electronic equipment that will be used against us. These units will be trying to intercept communications and from this determine unit composition, position, and intention. They will also be using measures to disrupt communications and break down our command and control.

In the past, we have been careless in our use of communications equipment and procedures. There were unfortunate incidents in the Vietnam conflict when the enemy used imitative deception to call in US air strikes on our own forces. There are other examples of the enemy calling our choppers into an ambush or falsely warning them away when they were on a rescue mission. One of our biggest weaknesses has been that we like to hear ourselves talk on the radio waves. So does the enemy. If he isn't monitoring for intelligence, then he's probably using direction finding and preparing to jam or fire on us.



We have the same capabilities as the enemy in this electromagnetic environment. How do we outperform him and win the first battle? We maximize the enemy's vulnerabilities while we minimize our own. The first step is that everyone--the commander, the C-E officer, the staff member, and the radio operator--be made aware of the threat in the electromagnetic environment. The threat includes locating, monitoring, and jamming our communications devices as well as deception of our equipment operators. Everyone must understand that the enemy places a high priority on exploiting intelligence gained from our use of radios, radar, and other electronic emitters.

The next step is to be able to employ the right electronic counter-countermeasures against the threat. Some of these involve very simple communications practices like using authentication procedures and changing radio frequencies and call signs more often than we have in the past. We must use counter-countermeasures effectively if we want to continue to operate in the high threat environment and go on to win the first battle. All personnel must be trained to recognize the enemy's electronic activities and know what to do about them. This is especially true of the commander and the operator who are the two prime targets of the enemy's efforts. (As we get further into the manual, we'll go into more detail on Electronic Warfare, particularly in chapter 4.)

We must be prepared to operate on the battlefield with the minimum amount of communications. Commanders must be prepared for the fact that their communications effectiveness will be reduced during the fight. It is at the most critical stages of the battle that loss of communications is most likely to occur -- the moment of increased electronic activity. Then it may be more to the enemy's advantage to jam us than to listen for useful intelligence. Commanders and staff have come to expect the best in command and control and communications. We must change this thinking. We must exercise our alternate communications means to insure that they are dependable when they're needed. We must also prepare for reduced effectiveness of our communications resources. We should exercise doing without electronic communications, or with only intermittent communications, for periods of time during training. If we don't, we will be further conditioned to believe that good communications will always be available. Unless electronic warfare becomes a continuing part of our preparation for the fight, we will be surprised, shocked, and ineffective when we encounter it for real.

The next five chapters in this manual tell how communications-electronics fits into the whole scene on the battlefield. They show how we will fight and win in the electromagnetic environment.

CHAPTER 2

Chapter 2. Training for the Fight

Why is training so important?
What's different about a signal unit's job in a training exercise?
What's involved in collective training?
What's involved in effective individual training?
What are a few of the elements that must be worked into training?

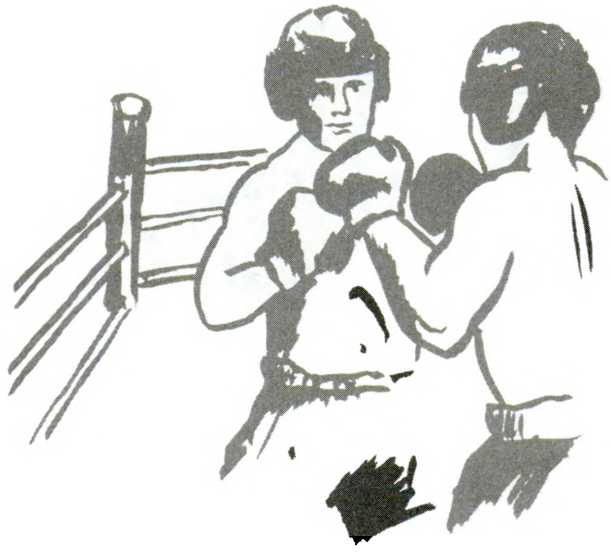
Training for the Fight

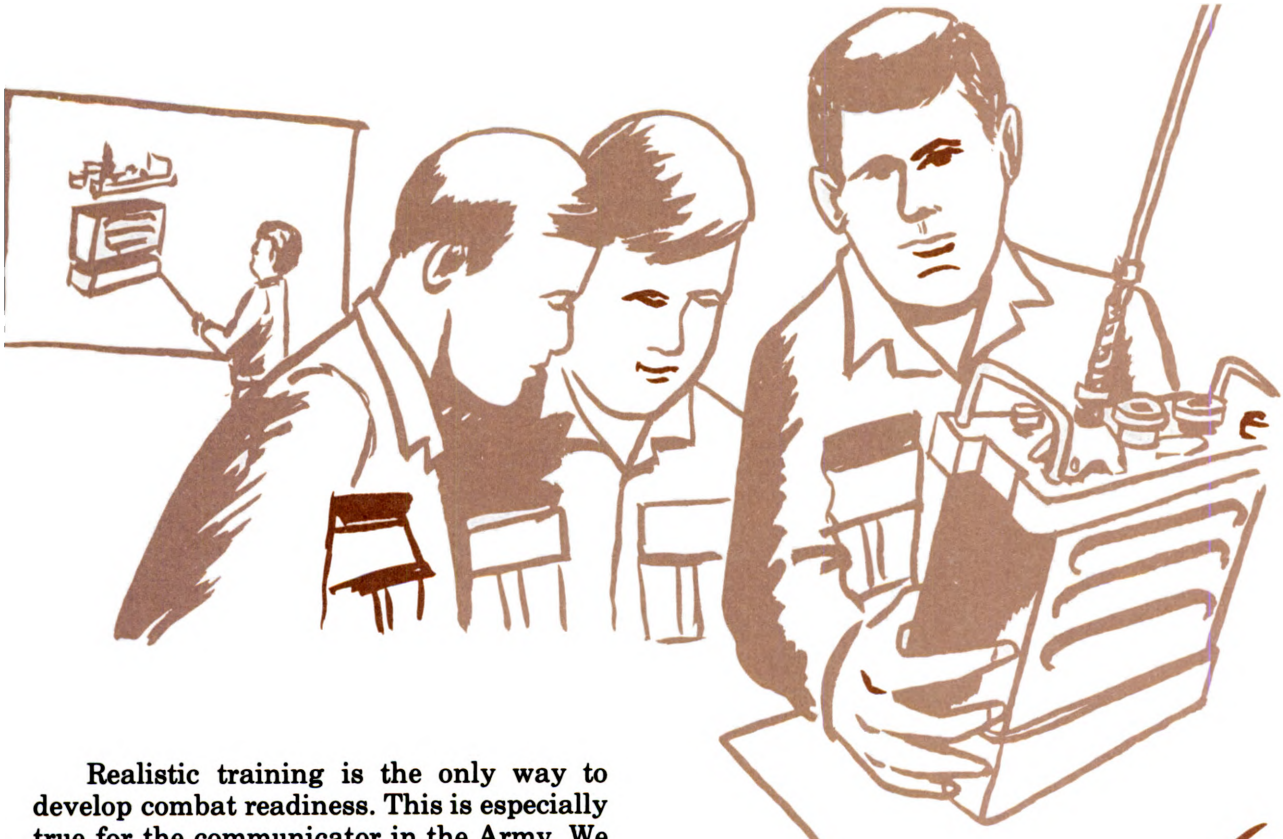
Why is Training so Important?

Before we get too far down the road to the first battle, we'd better take a careful look at what goes into winning. We can't win unless we are ready for combat. We won't be ready unless we've trained and planned carefully. In this chapter, we're going to talk about training for the fight. In the next chapter, we'll get into planning for the fight.

To get a feeling for what goes into training for a fight, put yourself in the place of a good boxer. --You, as an experienced boxer, have been training hard. You and your trainer have come up with a training program designed to get you ready to win. You have been running and exercising to get into top shape and build up your endurance. You've been jumping rope to sharpen your timing and reflexes. You've worked out for hours on the speed bag to sharpen your coordination, and spent an equal amount of time on the punching bag. Your sparring partners are good. The hours you've spent in the ring with them have given you realistic experience for your championship fight. You've worked with sparring partners that are the same size as your opponent and use his style of boxing. All this is to make sure you've trained as well as you can, because you want to be ready to win.

There is a lot to be learned from the way a boxer trains for a fight. He doesn't just go to the library with his trainer and study *The History of Prize Fighting, Glossary of Fighting Terms, and The Use of Leverage in the Art of Boxing*. He doesn't if he wants to win. He looks at books and maybe some films of his opponent. Yet, the major part of his training is spent developing the skills he needs in the ring and getting completely realistic training with his sparring partners.





Realistic training is the only way to develop combat readiness. This is especially true for the communicator in the Army. We can't train radio or radio teletypewriter (RATT) operators in just a nice classroom environment. We'd soon find them completely paralyzed by interference or frequency problems in a field situation.

Good training enables a unit to accomplish its mission. For a signal unit, that mission is to provide good communications. When a signal unit is well trained, the amount of C-E equipment loss and replacement is reduced. Repair and maintenance are kept to a minimum and spare parts can be conserved. Above all, reliable communications are provided and maintained.

One of the most important payoffs from effective training is an increase in morale. A unit that is well trained is confident it can accomplish the mission and will perform that way in the field.

In this chapter, we'll look at the importance of realistic training. We'll look at the big difference in a signal unit's job in a training exercise. We'll center in on collective training, which is the training of teams and units, and we'll hit the main elements in

individual C-E training. Finally, we'll see some of the important aspects of C-E training which could help us win the next fight.

What's Different About a Signal Unit's Job in a Training Exercise?

One of the first points we want to make in this chapter is the role that a signal unit plays when it's supporting a larger unit. When a division signal battalion is supporting the division in a field training exercise (FTX), it's mainly involved in training its personnel, right?--WRONG!--A signal unit provides a service to other units. When it's participating in a training exercise with a unit it's supporting, it does not, will not, and should not be expected to train during the exercise. It operates during such exercises. The bulk of the training must occur before it goes to the field to support an exercise.

Any signal organization that doesn't adequately train its personnel before providing communications for another unit will run into serious problems. It costs a tremendous amount of money to move a division or even part of a division to the field for an FTX. The cost of POL for the vehicles, and sometimes aircraft, the wear and tear on the equipment, the cost of food, all of these add up. The unit cannot train unless it has adequate communications, so the division signal battalion must be trained before it participates in such an exercise. If it isn't trained, the parent unit can't train its staff and can't get the training that good money is being spent for.

What's Involved in Collective Training?

The usual approach in talking about training is to start with individual training and then work up to collective training. We're going to work it the other way here, because effective collective training is absolutely essential for communicators. You could have the Army's most capable, best trained RATT operator at your disposal to pass messages along. Yet, if the messages aren't received at the other end, the job is not being done. It's a lot like a football team executing a pass play. The linemen can do an excellent job. The backs can block beautifully. The quarterback can get all the time he needs and throw a perfect pass. Yet, the play is not successful unless that receiver, downfield, makes the catch. This team aspect of training applies heavily to the communications-electronics (C-E) mission on the battlefield.

As we said, collective training refers to training teams and units. Good collective training must be realistic and performance-oriented. The objectives in collective training must spell out what the team or unit *Task* is. They must specify the *Conditions* under which the task will be performed and the team or unit *Training Standards* that must be met. Details on collective training can be found in FM 21-6,*"How to Prepare and Conduct Military Training."*

● ARTEP's--This performance-oriented approach to training is at the heart of the Army's ARTEP development. ARTEP? That's an Army Training and Evaluation Program. It's designed to help a commander train and evaluate his unit's combat readiness. It helps to check on the unit's past training and provides a guide for future training needs. Let's select one task from an ARTEP to get a feeling for training objectives. ARTEP 11-35, Army Training and Evaluation Program for Signal Battalion, AIM Division, lists the following as one mission for a RATT section/team:

Mission: Provide RATT station.

One TASK in accomplishing that mission is broken out as follows:

TASK:--Install doublet antenna.

CONDITIONS:--A subordinate AN/GR-142 RATT station is providing radio services to a supported division element. A need to extend the transmission range of the radio set has been determined.

STANDARDS:--

1. Within 1 hour, the doublet antenna will be--

   a. Cut at the length reqired by the assigned frequency chart in TM 11-5820-467-15, the conversion formula, or a frequency calibrated tape;

   b. Installed at a location that provides the best possible transmission and reception consistent with adequate concealment;

   c. And positioned broadside to desired direction of transmission with a maximum of 5° variance.

2. The changeover from whip to doublet antenna will be coordinated with the net control station and accomplished with no more than 5 minutes absence from the assigned net.

3. The AN/GRC-106 ANT TUNE and ANT LOAD will indicate in the green and minimum standing wave ratio verified.

ARTEP's aren't the cure-all for every training problem that can come up in a unit. But they can go a long way to help get a unit combat ready. In the past, the task on installing a doublet antenna might have read something like this on a weekly training schedule: *"A 2-hour block of instruction will be presented on the theory of doublet antennas. Students will learn about fabricating a doublet antenna."* The ARTEP provides a specific objective for the team with realistic circumstances and a performance-oriented task.

● Necessary Payoffs From Good Collective Training--The primary payoff from good collective training is *good communications.* Four additional payoffs are *reduced equipment repair and maintenance, increased flexibility, better problem-solving ability,* and *increased morale.* The *reduced equipment repair and maintenance* that we mentioned earlier is a payoff that can't be overemphasized. If your people know how to operate the equipment properly, it will be there when it's needed. *Increased flexibility* comes from personnel being cross trained. To be effective in a combat situation, a team must cross train beforehand. The pure mathematics of the situation in a unit shows why cross training is needed. The ratio of equipment to operator personnel in a unit shows that an operator must master a variety of skills with a lot of different equipment. Let's look at a multichannel communications team in a division. There are three men on the multichannel rig. They are responsible for the multichannel radio gear, plus a single channel radio on board. But, they are also responsible for the 5/4-ton truck and the trailer with two generators. When they get to a site, it's obvious that each man must be able to operate the radio gear. However, each man must also be able to drive the truck, start the generators, and pull maintenance. Each team member must be able to erect the antennas, ground the rig and the generators, maintain the trucks, and plot an azimuth. Additionally, they are always involved in site preparation, improvement and defense.

Then, there are the associated skills that keep you straight on the battlefield. Such things as using good marksmanship, camouflage techniques, reading strip maps, and reading multichannel annexes to operations orders keep the team functioning.

Another payoff that comes from good collective training is *better problem-solving.* If a team is hit with realistic problems in training, they'll be able to overcome the problems they're sure to meet in the field. If a team has to improvise to get a good ground or has to build a field expedient antenna in training, they'll be able to overcome those problems and others like them in combat.

Probably the biggest payoff, other than improving skills, is the *increased morale* that can develop with good collective training. A soldier will give his all for the group if he has that "team spirit." If RATT operators train together and work to help each other learn, there is less chance of the old excuse *"Well, the trouble's at the other end"* being thrown around whenever a snag is met. There isn't the feeling that it's not my problem, it's the other guy's. If the team isn't doing the job, every member of the team is in trouble.

What's Involved in Effective Individual Training?

The people on the teams we've talked about must receive their individual training before they join the team. Most signal specialists are given advanced individual training in training centers or Army service schools. Upon graduation, specialists have a working knowledge proficiency in their military occupational specialties (MOS). Working knowledge, as a level of proficiency, means that the specialist has acquired the essential knowledge to perform a job under qualified supervision. The specialist is not considered to be fully qualified. One exception to this practice is the training of cryptographic maintenance personnel. By Department of Defense directive, these

personnel *are* trained to be fully qualified. The *working knowledge* proficiency of most signal specialists places a specific training requirement on the shoulders of the signal unit commander. This requirement involves continued individual training for increased proficiency, training in the operation and maintenance of new equipment, and cross training in a related MOS.

The young officer coming into the Signal Corps could receive training in a variety of MOS's from telecommunications center operations officer to telephone digital communications officer. Where the enlisted man is receiving training to become a specialist, the officer is receiving an overview of the system to help prepare him to be a manager and a leader. We'll see how the officer's training comes into play for planning in the next chapter.

If you look back at the description of the battlefield in the last chapter, it's obvious that we need soldiers who can think fast, act

fast, solve problems quickly, and adapt to rapid changes in combat. Effective training helps equip a person with the specific skills that are being taught. But, more importantly, it prepares a person to be a better problem solver and to be able to adapt to changes quickly. In the Arab-Israeli War of 1973, tactics and problems were changing each day that the fighting progressed. When the tanks couldn't communicate because of jamming, the tankers had to invent ways of coordinating their movements with visual and sound signals. When the tanks were being destroyed as they rolled ahead alone, a new combined arms approach had to be used immediately. The US Army needs soldiers who can think fast, adapt to change, and make the right decisions when they're faced with problems in the next fight. Better training can help the soldier to meet these challenges.

● Soldier's Manuals--Just as the ARTEP is a key training tool for the unit, the Soldier's Manual is the central training document for an individual MOS holder. The Soldier's Manual tells the soldier exactly what is required of him at any given point in his career and how his performance will be evaluated. It lays out in real world performance terms what the Army requires a soldier to do in his MOS, skill level, and duty position.

● Trainers--Throughout this discussion of collective and individual training, we've made no big mention of who is responsible for the training. In a real sense, each individual soldier is responsible for keeping up his skill level and for pursuing advanced civilian education. When a team is training, each member helps the other and, in that way, each member is a trainer. In a formal sense, the commander at all echelons is responsible for the planning, conduct, and supervision of his unit's training. The staff officer who accomplishes the task of recommending the proper planning and programing of a unit's training is the unit's operations officer (S3). The supervisors, right on down to the firstline supervisor, must each take an active role in making sure that training is thorough, realistic, and performance-oriented. We can't go into great detail in this manual about how to train. There are other manuals for that purpose. FM 21-6, *How to Prepare and Conduct Military Training*, can be a big help to field trainers. One point that manual makes very vividly is that training is the most important unit activity in peacetime.

What are a Few of the Elements That Must be Worked Into Training?

A few important lessons have come out of the conflicts around the world in the last few years. If we are not learning from these lessons, we are doomed to repeating the same mistakes others have made. The biggest lesson is that we can't become so reliant on certain means of communications that we would be crippled without them on the battlefield. This is particularly true of radio communications. We must train to operate on the battlefield with limited communications. A follow-on to this is the need to train for alternate means of communications. The third element is the need for everyone who is involved with communications to train in the proper use of communications assets. And finally, the fourth element to be worked into C-E training is the close teamwork that the Army, Navy, and Air Force must exercise in the next fight.

● Training for Reduced Communications--Electronic warfare (EW) will probably be extensive in the electromagnetic dimension of the battlefield in the next fight. The enemy is liable to jam our communications at any time. He will be listening for all the information he can get. He'll be using direction finders in an attempt to locate our positions. We must be able to function in spite of the enemy. We'll be throwing our best EW efforts at him too. Our personnel must know how to use proper electronic counter-countermeasures (ECCM). They must know how to use alternate types of antennas to beat the enemy's efforts. Our

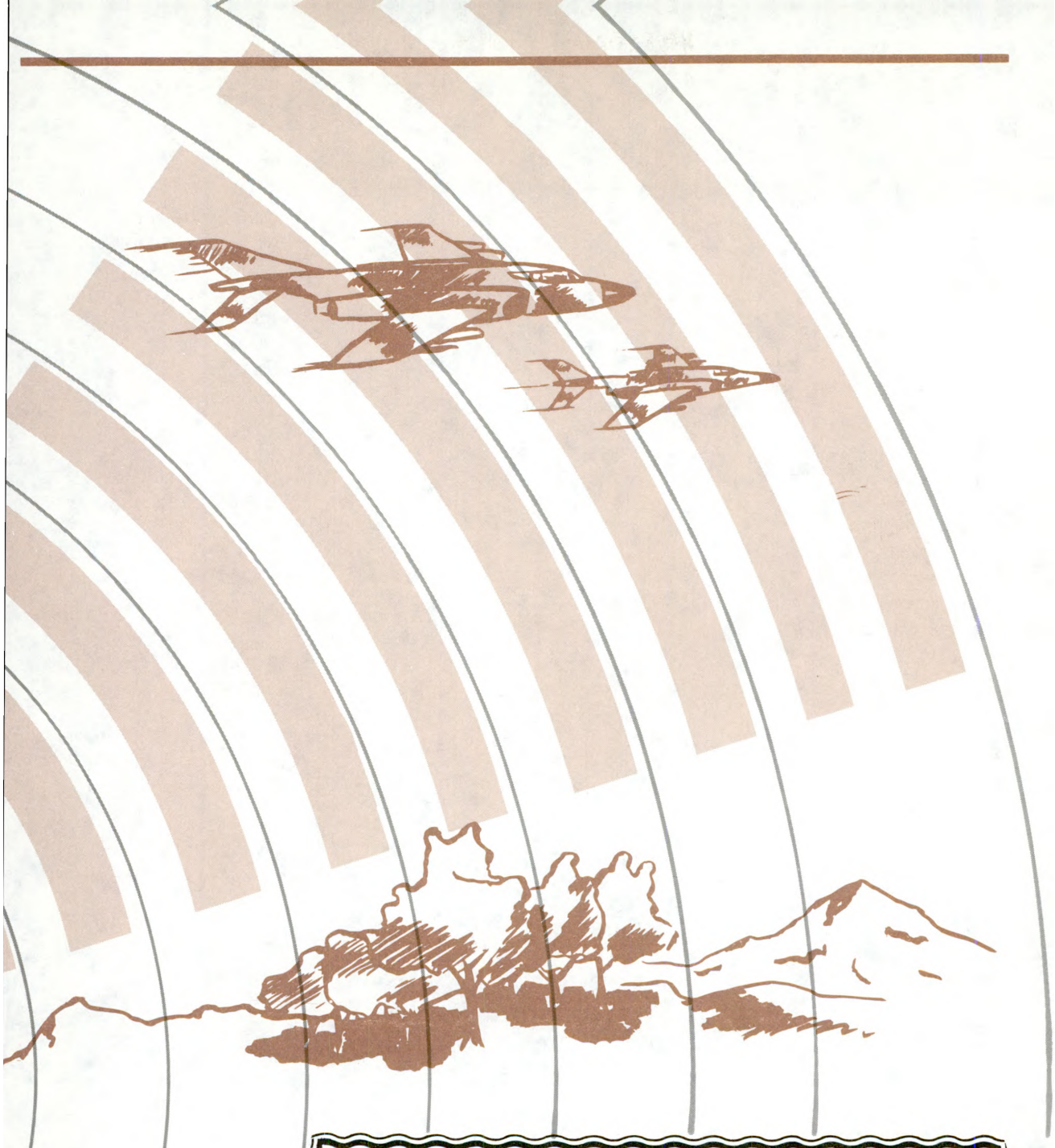
operators must submit interference reports, so we can take action against the enemy if it's him at work. (Specific information on ECCM will be covered in Chapter 4 and information on interference reports and antennas can be found in the appendixes.) We have to preplan our missions carefully, so loss of communications doesn't stop us on the battlefield.

● Training for Alternate Means of Communications--Another way of continuing to communicate, in spite of the enemy's efforts to stop us, is to go to another means of communications. When the enemy jams us and takes our communications out, many times old International Morse Code can get the message through. If all radio communications is taken out, messengers and wire communications can be used. Also, preplanned sound and visual signals can keep the troops together, functioning as a team on the battlefield. Whether it's whistles, flags, lights, horns, bells, or smoke, whatever works must be used.

● Training Everyone Who Uses Communications--Sometimes there is a misunderstanding that only personnel holding communications MOS's have to continually train in the area of communications-electronics. If we're going to be successful on the battlefield, all personnel who are authorized to operate in a voice radio net must receive C-E training. This includes the battalion, brigade, or division commander; the staff officers; the CG's aides; and anyone else who operates in voice nets. These individuals must be trained to use the equipment as well as learn how to maintain security on voice radio nets. This means they must know how to use SOP, CEOI, brevity lists and other authorized codes and ciphers. They must be aware of the fight in the electromagnetic environment, the same as C-E personnel.

● Teamwork With the Other Services-It's very unlikely that the Army will be going into the next battle by itself. We'll be in the fight along with the Navy and Air Force. In fact, we might be involved with the services from allied nations as well. The coordination between the Army and the Air Force is particularly important because modern battles are fought and won by air and land forces working together. When we are involved, it's essential that all of our communications marry-up so we can carry on the well coordinated fight that will be a key to winning. We will also have to cooperate in our use of the electromagnetic environment or we could end up interfering with our own people. This kind of cooperation comes from practice and must be incorporated into our C-E training.

Training as we've outlined it in this chapter is part of the preparation for the fight. In the next chapter, we'll look at the other part of preparation--planning for the fight.



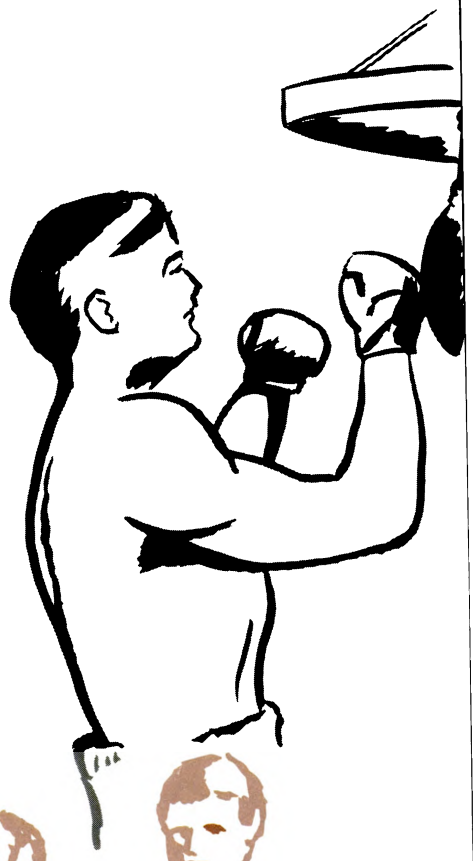
Modern battles are fought and won by air and land forces working together. Joint training is absolutely essential if the Army and Air Force are going to fight effectively. They must train so they can talk to one another. (i.e., exchange of encryption codes and suppression programs, and the request and control of air support.) They must train to prevent mutual interference between Army and Air Force C-E systems.

CHAPTER 3

Chapter 3. Planning for the Fight

Why is planning essential?
What is the mission?
How do troops affect requirements?
What are some other things to consider about the mission?
What about the enemy?
What about communications equipment?
What can the equipment do?
How is the detailed plan developed?
What's involved in site planning?
How do special environments affect communications?
Where can you find more information on special environments?

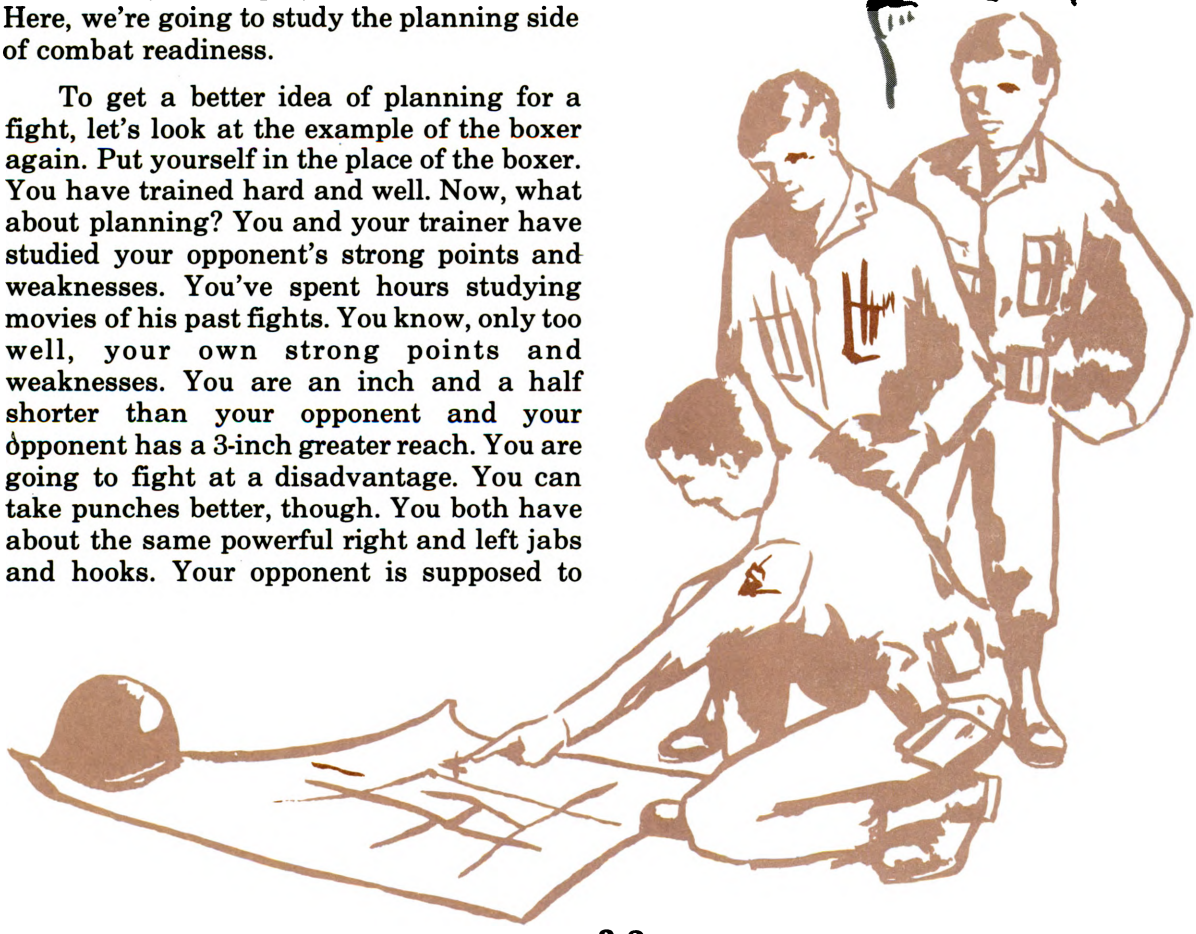
Planning for the Fight

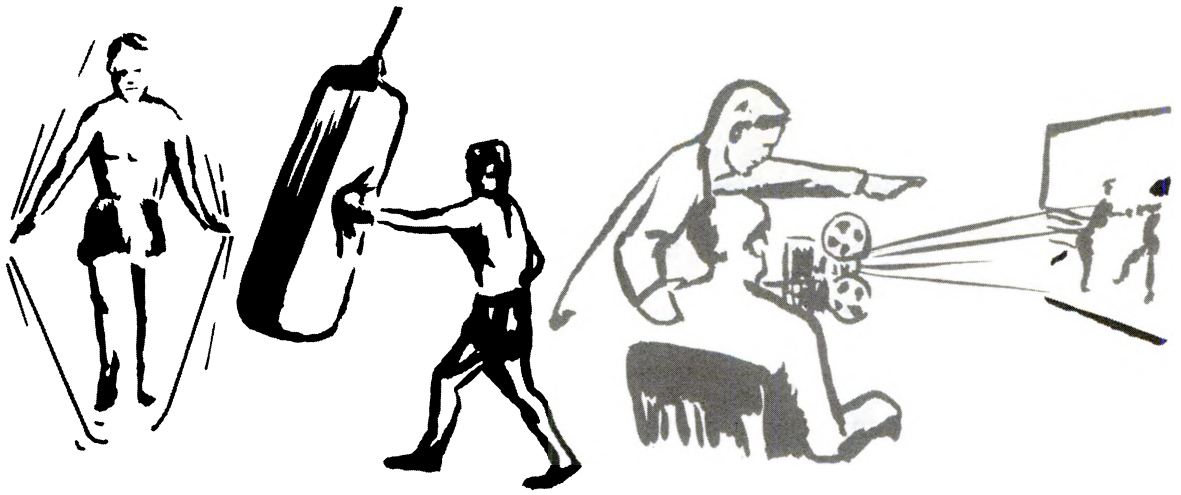


Why is Planning Essential?

We said at the start of the last chapter that you can't win unless you're ready for combat, and you won't be ready unless you've trained and planned carefully. We looked at the training side of preparation in chapter 2. Here, we're going to study the planning side of combat readiness.

To get a better idea of planning for a fight, let's look at the example of the boxer again. Put yourself in the place of the boxer. You have trained hard and well. Now, what about planning? You and your trainer have studied your opponent's strong points and weaknesses. You've spent hours studying movies of his past fights. You know, only too well, your own strong points and weaknesses. You are an inch and a half shorter than your opponent and your opponent has a 3-inch greater reach. You are going to fight at a disadvantage. You can take punches better, though. You both have about the same powerful right and left jabs and hooks. Your opponent is supposed to





have a glass jaw. After you go over all the facts, you and your trainer come up with a good fight plan. This is the only way to win.

You are going to try to win early in the fight. You're going to dance and keep him coming at you. You've got to keep him from getting you on the ropes. Then, you are going to move in tight and go for his chin. If you can, you are going to get in a few good uppercuts and try to finish him off. You have done everything you can to get ready for the fight. You have trained well and planned carefully.

There are a few lessons to be learned from a boxer planning for a fight. He always keeps his opponent in mind, and he's as thorough as he can be. The same basic approach has got to be used by anyone who's getting ready for a fight--if they want to win. This applies to a corps commander, as well as to a team chief who is preparing for a mission. In this chapter, we'll take a look at what goes into good, thorough planning. We'll look at the types of equipment that are available for communications and check their strong points and weaknesses. We will follow the approach a C-E officer would take in planning for an entire signal system, and we'll see what a platoon leader would do in planning for a communications site. This will give us a feeling for planning at different echelons. Finally, we'll examine how different environments affect the equipment and the personnel that provide communications. It sounds like a lot of ground to cover, but things will fall in line, one right after the other, as we move on.

What is the Mission?

This is the first place to start when you're laying out the plans for a fight. It's just like the boxer who knows that his mission is to fight a certain boxer at a specific place and time, and to win. You must know what the mission is so you can gear your planning to accomplish the mission. If you are at an echelon where you're planning for an entire communications system, then you must study the mission of the entire fighting force. If you are planning for the location of one communications site, you must study the mission of the units you'll be supporting. You don't want to be planning for an elaborate defense setup with permanent pillboxes, bunkers, and trenches if you'll be supporting units that are moving every couple of hours.

Planning requires the careful application of good common sense. When you look at the mission, some of the questions you should be trying to answer are: How fast will the units be moving? How will the phasing of the operations fall in line? How will the major

forces be used in the fight? What will be the size and needs of reserves? Will there be any static or slow-moving elements to support? Where will the command posts be located, and how often will they be relocating?

It becomes clear, very fast, that the only way to get the information that's needed about the mission is through close coordination with the members of the commander's staff. When you're responsible for the C-E requirements, then you must be sure you keep a close working relationship with everyone who is involved with planning. You want to be sure you have all the information you need. If changes in the mission occur, you want to know about them as early as possible.

How do Troops Affect Requirements?

There are so many new weapons and delivery systems that tactics are changing at a quicker pace than ever before. There is a heavy emphasis now on the use of combined arms forces on the battlefield. The balances between armor, infantry, airborne, and air assault troops will vary from one situation to another. The obvious follow-on from this approach is that the communications needed to support the units in the next fight must be tailored to fit the changing requirements. Another thing to remember is that some units, like the artillery, will have a lot of organic communications, while others, like medical units, will depend on the C-E planner to give them enough communications support.

You have to consider every unit that needs communications support when you are coming up with a signal plan. You've got to be sure you include your own requirements too. By piecing together each of the individual requirements, you'll come up with the information you need to develop an overall plan.

What Are Some Other Things To Consider About the Mission?

● The Commander--Sometimes, you'll have to keep in mind any special requirements that the commander wants in the way of communications. Some commanders will want to keep in constant contact with their command posts and the next higher headquarters. Others will rely more heavily on their staffs for continuing operations and won't have as many special requirements. The important thing is to keep the commander in mind when you're planning for a system.

● The Other Services--It's unlikely that the Army will be undertaking any major mission alone. It will be essential that we keep a close working relationship with the Navy, the Air Force, and, possibly, the services from allied nations. Operations that involve the Navy will be heaviest in warfare on an island or peninsula, while the Air Force support accompanies us in all of our operations. Of course, these services have their own communications facilities. Yet, to effectively support you, their systems must marry-up with yours at the right points. Then too, the other services might have to depend on you to provide specific circuits which aren't within their own capability.

● The Area--The area where you'll be operating will have a major impact on your planning. You can be planning all sorts of nice line-of-sight shots on paper, then get to the area and find hills, mountains, or even a large city in the way. The terrain and size of the area, along with the weather, will have a tremendous influence on the communications. There is also a need to plan to use any existing communications facilities that might be in the area. These points are so important that we're going to get into them in more detail at the end of this chapter.

● Logistics--You can't forget about supplies, maintenance, and transportation you need for your equipment and personnel. Watch for the location and the makeup of the logistical complexes. Keep an eye on the rear boundary location and support that will be provided by higher headquarters when you're planning.

● Coordination--Who do I coordinate with in supporting C-E requirements? It will vary to some extent depending on where you fit in the chain of command. However, you must continually coordinate with all the staff elements of the unit you are working with. Personnel matters, such as replacements, must be continually coordinated with the S1 or G1. Security clearances, intelligence matters, and the EW threat will be items that you will work on with the S2 or G2. The S4 or G4, of course, is the guy you will coordinate with concerning logistical support. Last, but not least, let's talk about matters to be coordinated with the S3 or G3. When it comes to the nuts and bolts of a unit operation, this section is the focal point. This is where the operations order comes from. These people can tell you--if you're the C-E officer--when an operation will take place, what units are involved, where the units will be located, and what C-E support will be required. Continual, close coordination is a must. We must insure that any change which will affect C-E requirements is immediately passed on to us. So this means that we must have continual two-way coordination. Without it, we cannot operate effectively. Coordination and two-way communications must happen at all echelons. This goes all the way down to the platoon sergeant working with his lieutenant and first sergeant. If you continually check back and forth and reappraise your requirements and plans, you stay on a straight course toward success.

What About the Enemy?

The days when you could assume that the enemy would bypass communications sites for more lucrative targets are gone forever. Communications equipment is now among the most important targets in the combat area.The enemy, too, realizes that communications is the heart of command and control. Just like everything else on the battlefield, the communications sites are more vulnerable than ever before because of the more advanced and destructive weapons. Physical security has to be a major concern for anyone working on the plans for a communications site, as we'll see a little further on in the chapter. However, the biggest problem area for anyone involved with C-E is in the electromagnetic environment. You've got to prepare and plan for *Electronic Warfare* (EW).

To start with, we must get out of our dream world and away from an illusion of safety! We must accept the fact that the enemy probably *knows* every time we operate any electronic device. From there, we can take some positive action. First, we must use all the procedures, codes, siting principles, and the low power settings we've heard about for years. They help deny or delay the enemy from knowing all we are doing. Most of the time, he just wants to know what's going on and you never know he's there. But, what do you do when you're waiting for the order to move to that critical point on the battlefield, and BUZZZZZZ! You can't hear or speak to anyone on any electronic device. What happens then, communicator? What we need to do is plan and train for this event, *now*. It may come down to using runners, mirrors, horns, flashlights, electro-optics or even hand signals to communicate. We have to use whatever it takes to get the message through. How will the most isolated communications man report his being jammed? We have to get prepared for it. If he can report it fast enough, we may be able to knock out the enemy jammer. We can't get caught sleeping in the electromagnetic environment on the battlefield. The way to avoid this is to train and plan for electronic warfare.

What About Communications Equipment?

If you're planning for a communications system, you are going to be guided by the types and the amount of equipment that are available. You must consider all C-E assets that are available throughout the command. This includes what's available in the signal unit as well as the C-E equipment and personnel assigned to the tactical maneuver elements.

Sometimes you will find that requirements cannot be met with what's on hand. This could result from special requirements coming up, a lot of maintenance problems or because the enemy has destroyed some of your C-E gear. We still have to communicate and we can't let the commander down. He has to have that command and control no matter what. This means that we must know our equipment inside and out. We have to know how to make it work and how to reconfigure equipment and systems when we're in a tight situation. If we lose an antenna, we have to be able to come up with a *Field Expedient.* (See the appendixes.) These situations can call for a lot of ingenuity on the part of the communicators. The ability to make do with what you've got comes from training, field experience, and the desire to get the job done.

If you have to procure more equipment, you should use items compatible with those you already have. Keep in mind that special types of equipment, used in isolated instances, will put a real burden on planning, training, and operation. It will also be hard to get supplies and maintain the special equipment. In the long run, you could cut down the overall reliability of the communications system by cranking in extra equipment.

What Can the Equipment Do?

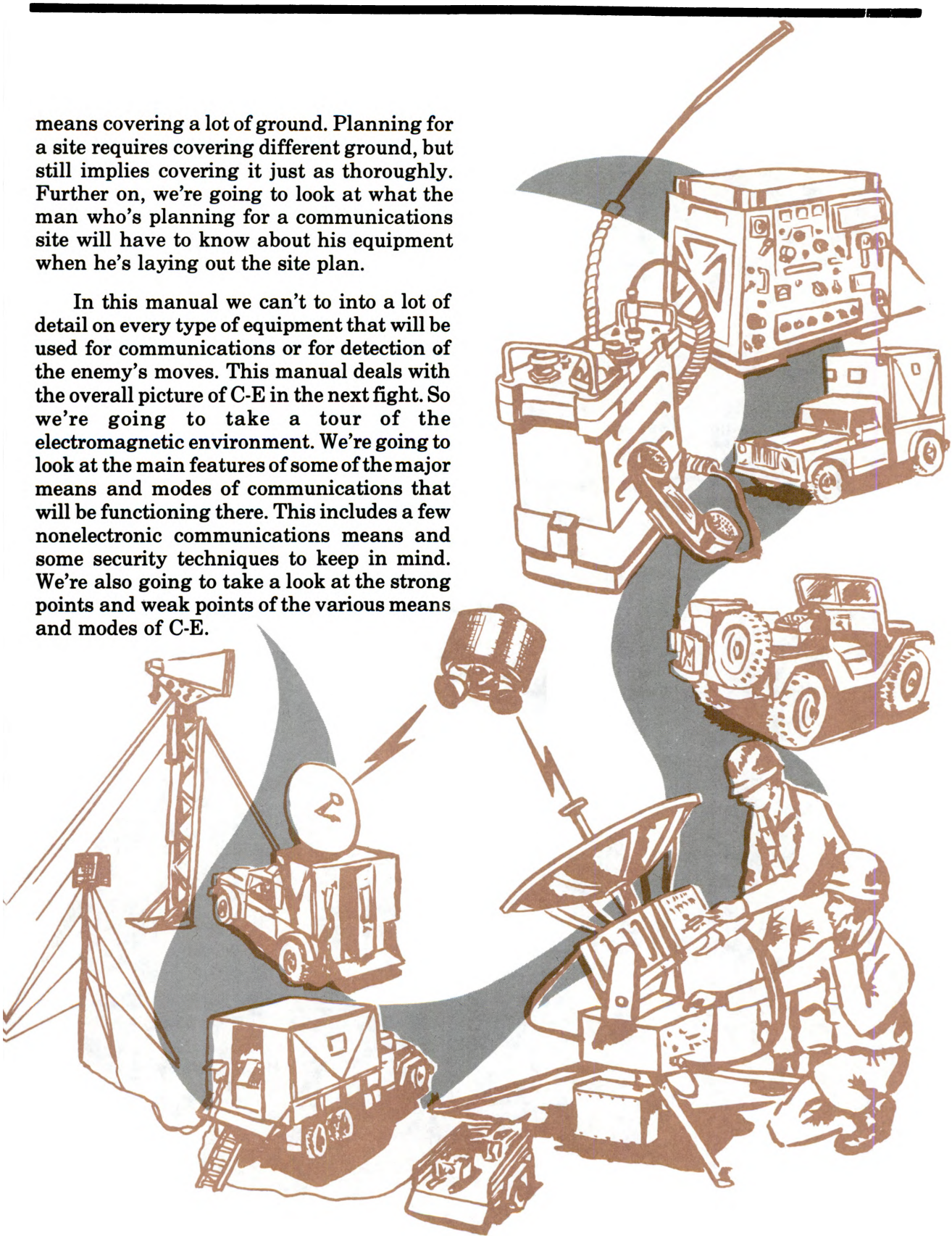
If you are a C-E officer working on the plans for a system, you can't be content with just knowing the types and amounts of equipment that are available. This information is of little value if you don't know and appreciate what the equipment can and cannot do for you. You have to know the capabilities, operating characteristics, and limitations of the equipment, so you can determine the communications it can provide.

Just knowing all about the individual items of equipment isn't the whole story either. You have to know how the system will operate after you put the components together. For instance, you should know the characteristics of telephone equipment when it's coupled with multiplexing facilities. These differ from field wire routes. Voice frequencies work great over either method of transmission. However, the ringing frequencies of the phone won't pass on the multiplexing routes. You must have additional equipment on both ends. This additional equipment converts the ringing signal into a frequency the multiplexing unit will accept and then changes it back at the distant end. Simply stated, you have to look at the big picture. In addition to the major equipment items, you must have all the add-on components that make the whole system work.

After you understand the way the individual items of equipment function as a system, there are a few more important steps to take. You should know which units have what equipment, in what amounts, and in what state of serviceability. This sounds like a whole lot of information to know. It is, so we're not trying to imply that you should memorize every last detail. You should have the information at your fingertips when you need it. Experience over time will commit a lot of it to memory. Planning for a system

means covering a lot of ground. Planning for a site requires covering different ground, but still implies covering it just as thoroughly. Further on, we're going to look at what the man who's planning for a communications site will have to know about his equipment when he's laying out the site plan.

In this manual we can't to into a lot of detail on every type of equipment that will be used for communications or for detection of the enemy's moves. This manual deals with the overall picture of C-E in the next fight. So we're going to take a tour of the electromagnetic environment. We're going to look at the main features of some of the major means and modes of communications that will be functioning there. This includes a few nonelectronic communications means and some security techniques to keep in mind. We're also going to take a look at the strong points and weak points of the various means and modes of C-E.



RADIO

Main Features:

- **Wireless -- can operate while mobile.**
- **Fast and can handle a large number of messages.**
- **Operates from ground to ground -- ground to air -- air to air -- ground to ship.**
- **Uses include --**

  Voice
  Radiotelegraph (CW)
  Radio Teletypewriter (RATT)
  Multichannel

- **Types of modulation it uses are --**

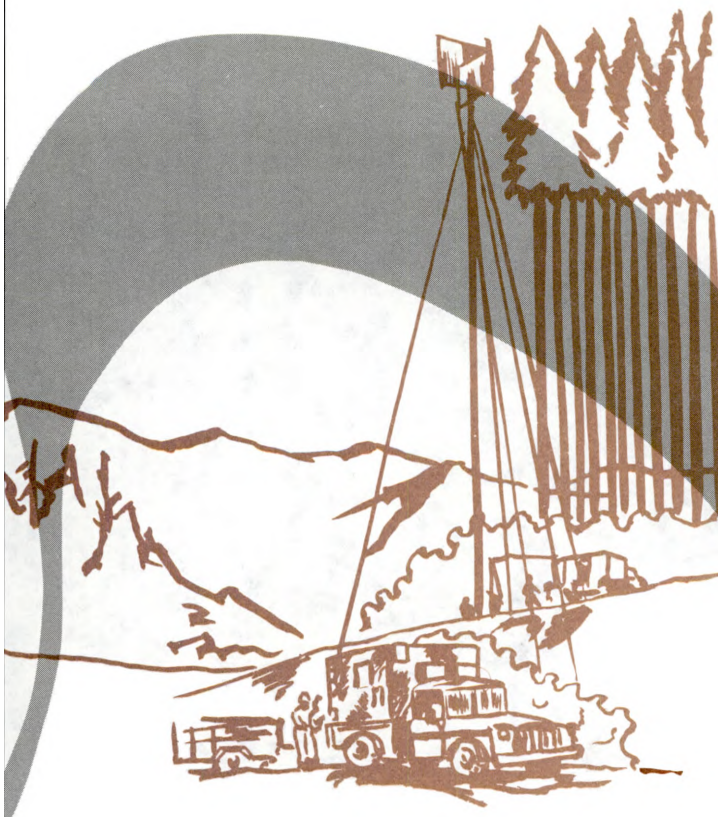
  Amplitude Modulated (AM)
  Frequency Modulated (FM)
  Single Side Band AM (SSB)

- **Primary frequencies used are --**

  High Frequency (HF)
  Very High Frequency (VHF)
  Ultrahigh Frequency (UHF)
  Super High Frequency (SHF)
  Extremely High Frequency (EHF)

- **Transmission paths include --**

  Ground Wave
  Skywave
  Line of Sight
  Tropospheric Scatter



Strong Points:

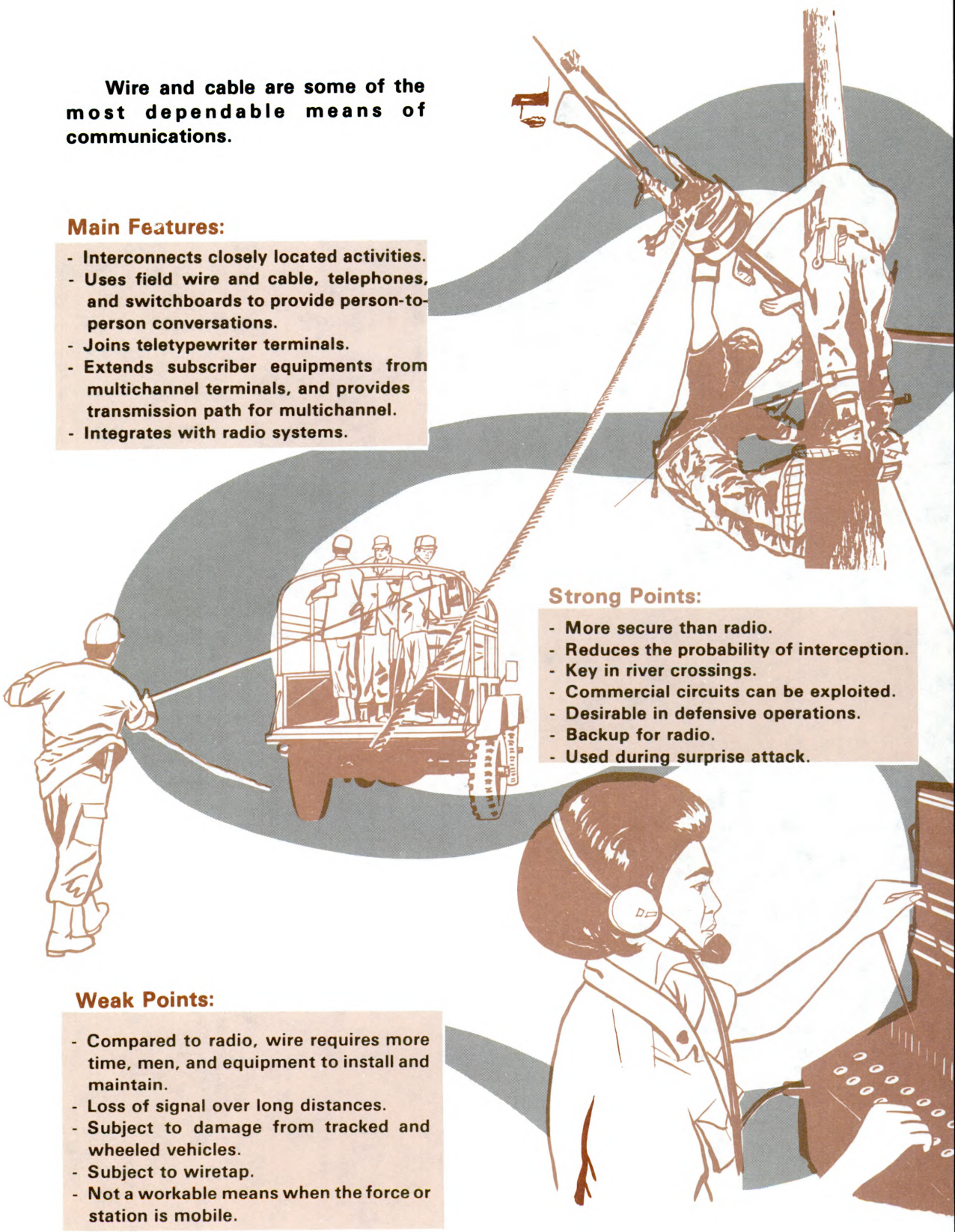
- Can span great distances.
- Remote operation can be used.
- Retransmission can be used to increase range and overcome obstacles.
- Requires minimum manpower and minimum space for equipment.
- Integrates with wire systems.
- Can be secured.

Weak Points:

- Unsecured radio is the least secure means of communications: It can be jammed or intercepted. Deception can be used.
- Radio is subject to interference from the atmosphere, the terrain, and manmade sources.
- Radio operation requires common frequencies, compatible equipment, and common range.

WIRE AND CABLE

Wire and cable are some of the most dependable means of communications.



Main Features:

- Interconnects closely located activities.
- Uses field wire and cable, telephones, and switchboards to provide person-to-person conversations.
- Joins teletypewriter terminals.
- Extends subscriber equipments from multichannel terminals, and provides transmission path for multichannel.
- Integrates with radio systems.

Strong Points:

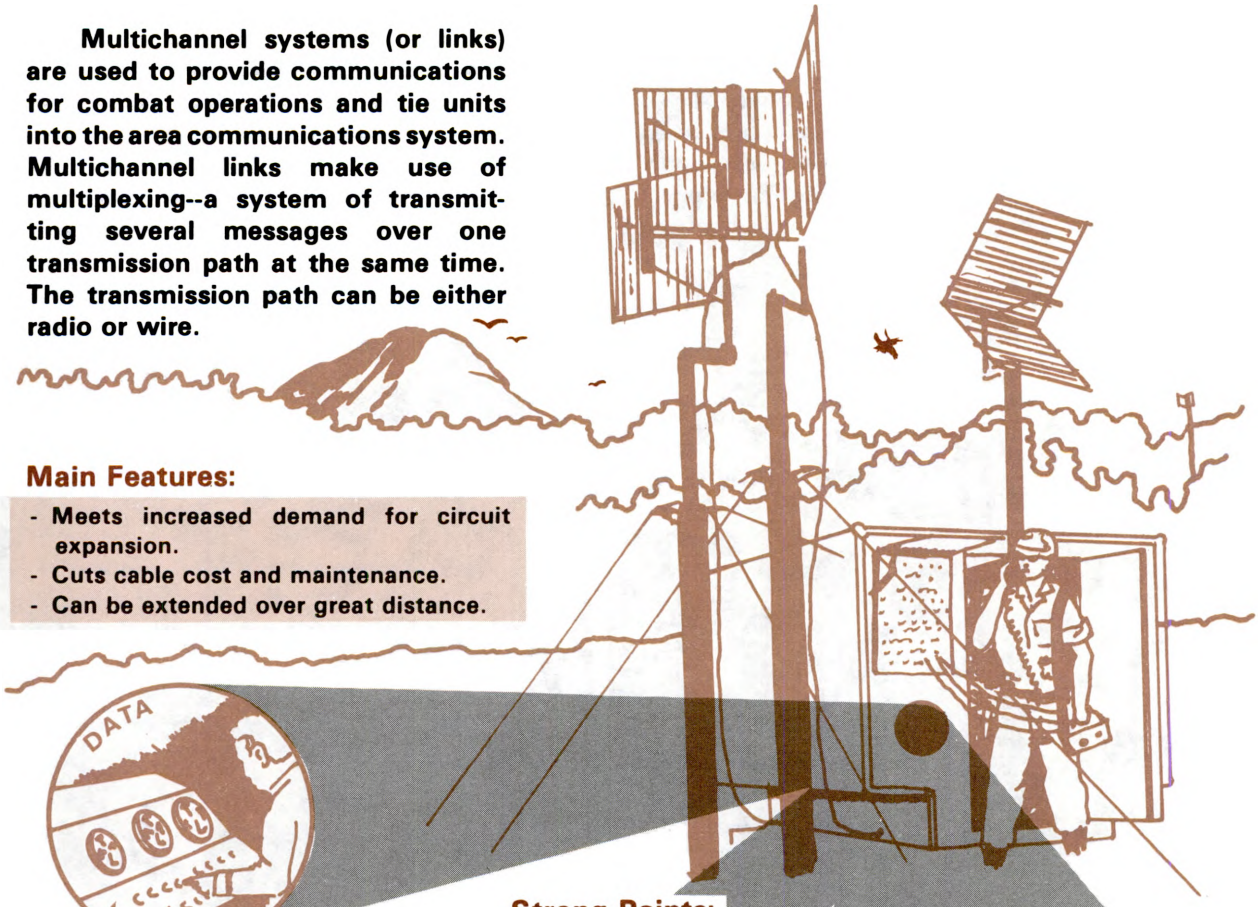
- More secure than radio.
- Reduces the probability of interception.
- Key in river crossings.
- Commercial circuits can be exploited.
- Desirable in defensive operations.
- Backup for radio.
- Used during surprise attack.

Weak Points:

- Compared to radio, wire requires more time, men, and equipment to install and maintain.
- Loss of signal over long distances.
- Subject to damage from tracked and wheeled vehicles.
- Subject to wiretap.
- Not a workable means when the force or station is mobile.

MULTICHANNEL

Multichannel systems (or links) are used to provide communications for combat operations and tie units into the area communications system. Multichannel links make use of multiplexing--a system of transmitting several messages over one transmission path at the same time. The transmission path can be either radio or wire.



Main Features:

- Meets increased demand for circuit expansion.
- Cuts cable cost and maintenance.
- Can be extended over great distance.

Strong Points:

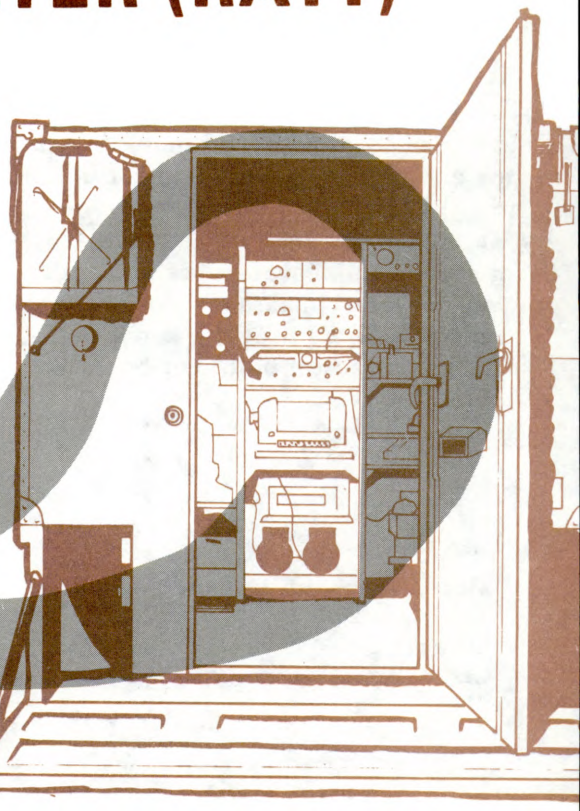
- Increased circuits over single path.
- Increased range.
- Builds up weak signals.
- Add and drop circuits along system.
- Can be secured.

Weak Points:

- Loss of cable or radio path drops all circuits.
- Large equipment reduces mobility.
- Large power requirements.

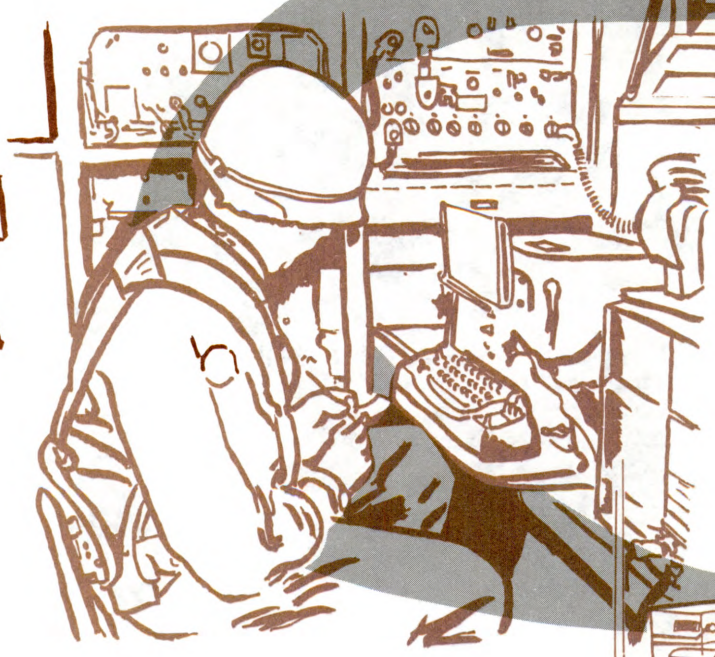
TELETYPEWRITER AND RADIO TELETYPEWRITER (RATT)

Teletypewriter provides a rapid method of transmitting messages over wire or multichannel circuits or by radio (RATT). Messages are received in the form of page copy or paper tape.



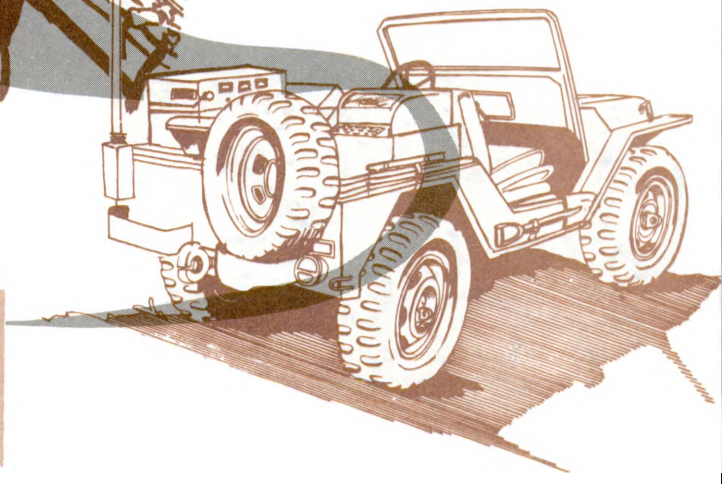
Main Features:

- Variable speeds.
- Accuracy.
- Page copy of message.



Strong Points:

- Easy to secure.
- Easily retransmitted.
- Point to point.
- Links to higher, lower, and adja headquarters.
- RATT is backup to multichannel ra tropo, satellite, and cable links.
- Alert warning.
- Rear area security control.

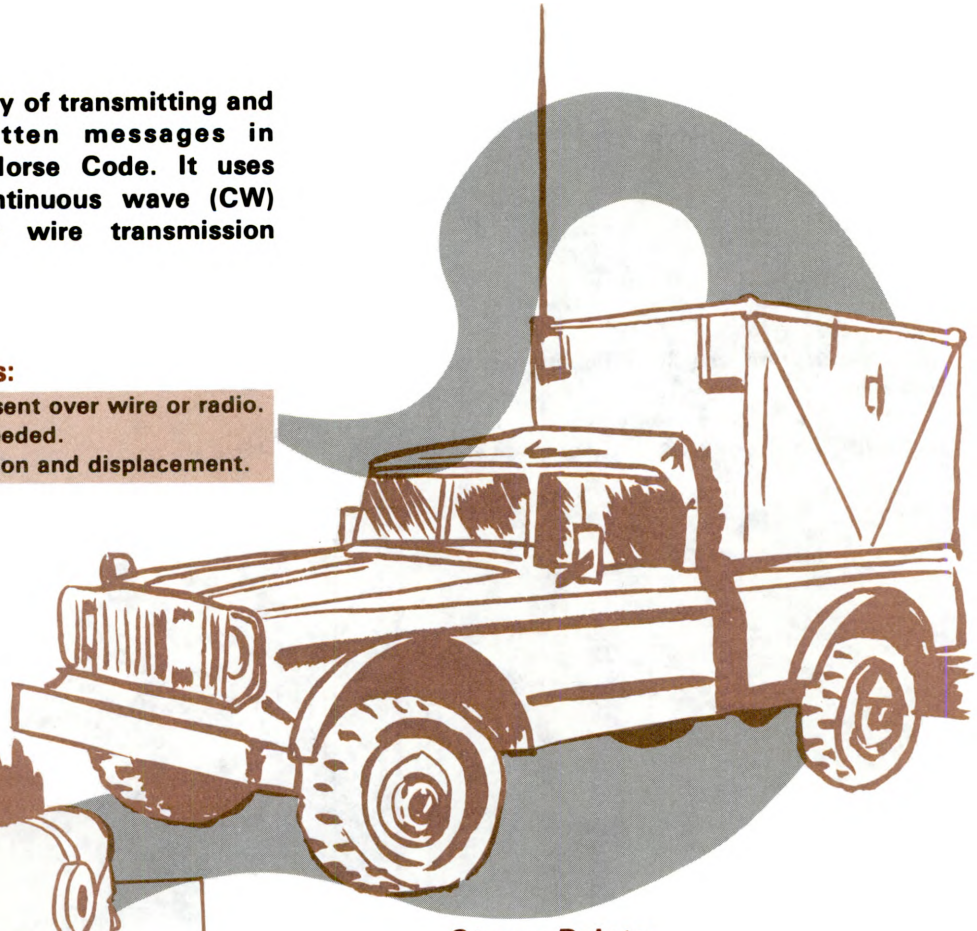


Weak Points:

- Needs higher quality circuits than voice.
- Increased equipment requires more power and maintenance than a simpler means.

CONTINUOUS WAVE (CW) INTERNATIONAL MORSE CODE (IMC)

CW is a way of transmitting and receiving written messages in International Morse Code. It uses interrupted continuous wave (CW) over radio or wire transmission means.

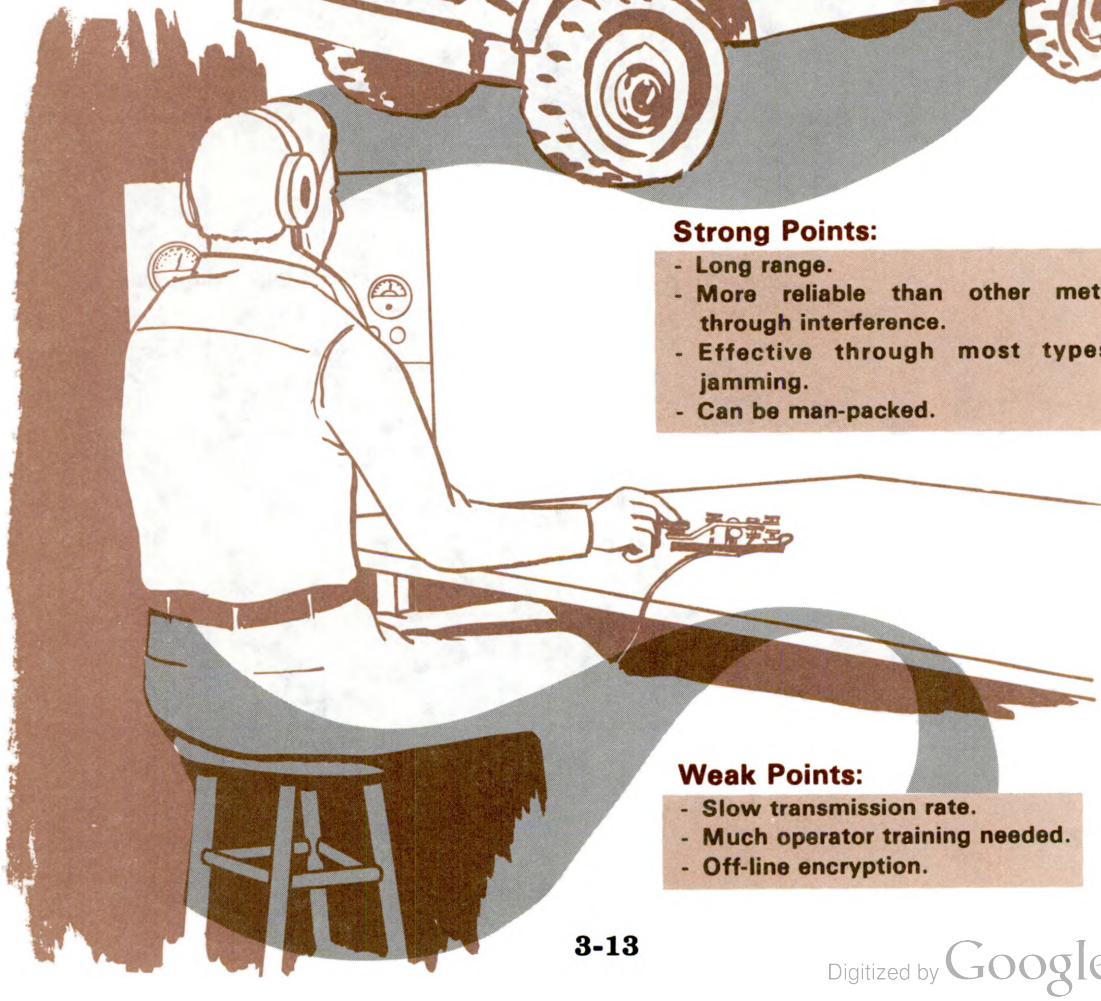


Main Features:

- Signal can be sent over wire or radio.
- Little power needed.
- Rapid installation and displacement.

Strong Points:

- Long range.
- More reliable than other methods through interference.
- Effective through most types of jamming.
- Can be man-packed.

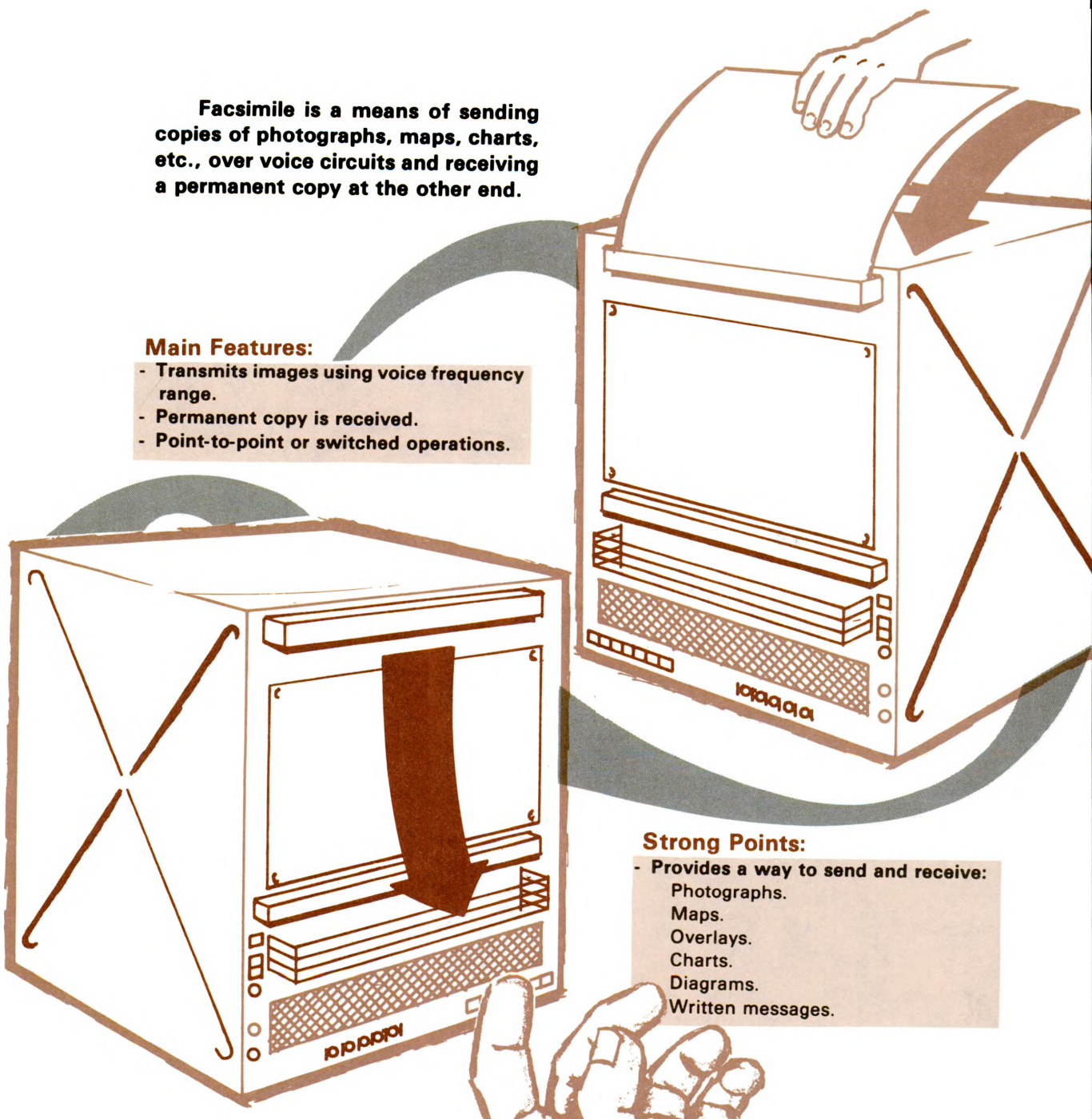


Weak Points:

- Slow transmission rate.
- Much operator training needed.
- Off-line encryption.

FACSIMILE

Facsimile is a means of sending copies of photographs, maps, charts, etc., over voice circuits and receiving a permanent copy at the other end.



Main Features:

- Transmits images using voice frequency range.
- Permanent copy is received.
- Point-to-point or switched operations.

Strong Points:

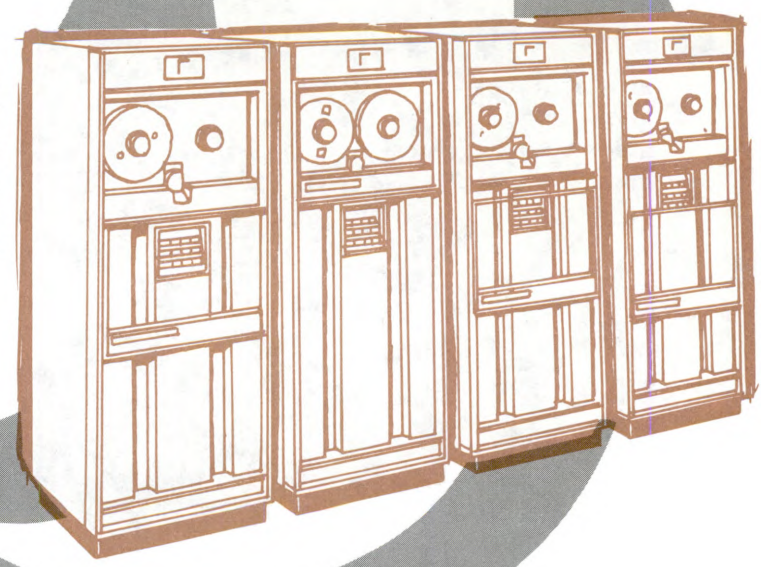
- Provides a way to send and receive:
  - Photographs.
  - Maps.
  - Overlays.
  - Charts.
  - Diagrams.
  - Written messages.

Weak Points:

- Requires high quality circuits.
- Nonsecure except over wideband circuits.
- Limited size of copy.
- Slow speed of transmission (approx 6 min per page) until new equipment is developed.

DATA

Data systems provide an electronic method of rapidly transmitting and receiving large amounts of digital and analog information. When we're talking about data, we're talking about the computer.



Main Features:

- High volume of information.
- Speed--real time message delivery.

Strong Points:

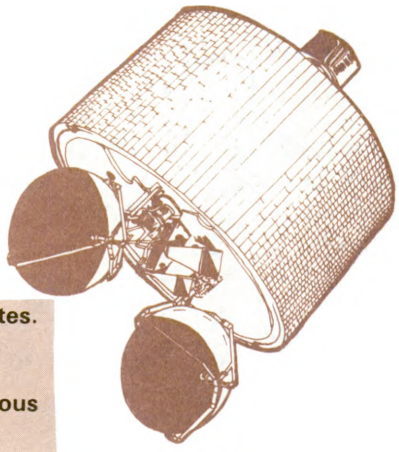
- Page copy.
- Video display.
- Programmable output.
- Programmable format.
- Stored data.
- Easily secured.

Weak Points:

- Highest quality circuits.
- High degree of maintenance.
- Needs controlled environment.

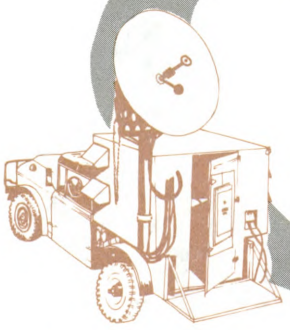
TACTICAL SATELLITE COMMUNICATIONS (TACSATCOM)

The communications satellite acts as a repeater station in the sky. Technology has brought us to the stage where we now have man-pack equipment for TACSATCOM.



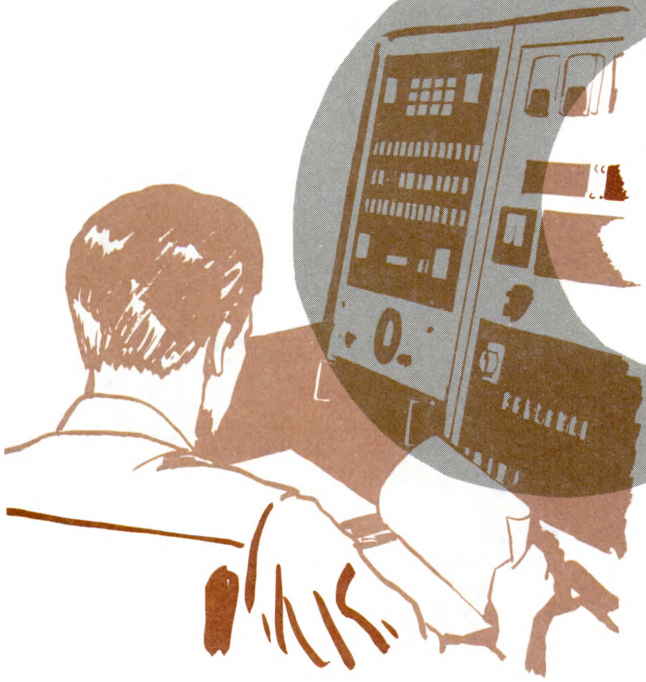
Main Features:

- Single repeater to connect remote sites.
- High data rate.
- Difficult to jam.
- Remote multiple access (simultaneous links).



Strong Points:

- Mobile
- Rapid terminal installation.
- Secure circuits.
- Built-in test equipment.
- Elimination of ground relay.
- Site location not restricted by terrain.

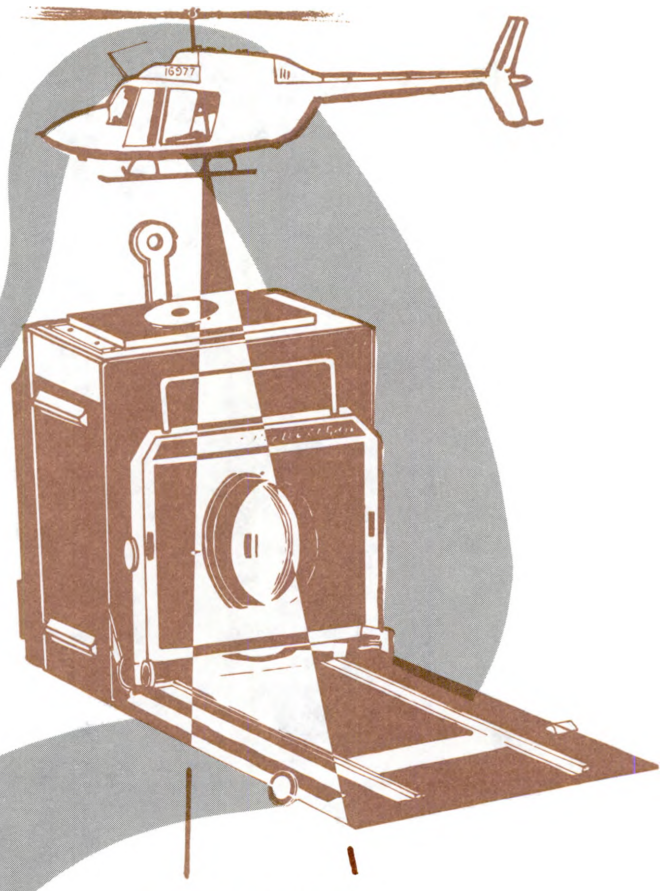


Weak Points:

- Needs wide frequency bands.
- Requires redundancy for reliability.
- Frequencies must be high enough to prevent reflection from ionosphere.
- Rain causes loss in signal strength.

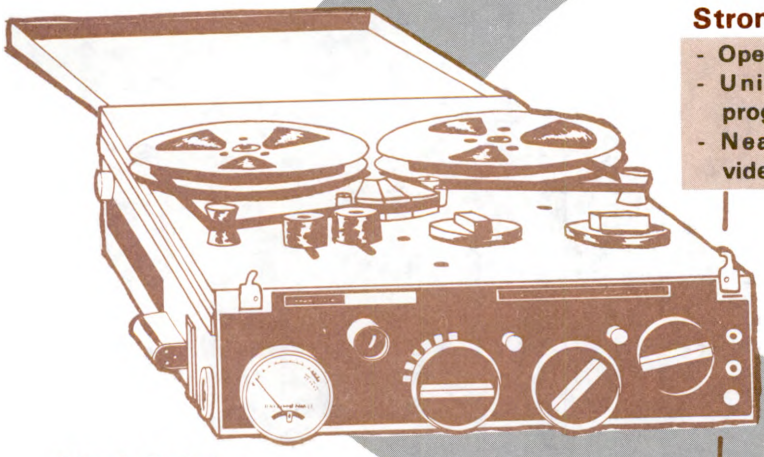
AUDIO-VISUAL

Audio-visual activities are concerned with the communication of information employing still photography, graphic illustrations, sound, motion pictures, and television. Functions of audio-visual support include the recording, production, storage and retrieval, distribution and presentation or display of visual images, sounds, and oral commentary.



Main Features:

- Provides information in support of tactical operations, such as:
  - Reconnaissance by aerial photography.
  - Information for decisions by the commander and his G2 or S2.
- Plays a major role in training programs.
- Widely used in psychological operations.
- Widely used in support of Army information activities.



Strong Points:

- Operational record of all information.
- Uniform instruction for training program.
- Near real-time information from videotapes and photographs.

Weak Points:

- Slow response time for tactical support requirements.
- Inadequate support available for tactical units.
- Limited to black and white photo processing at tactical level.

RADIO-WIRE INTEGRATION (RWI)

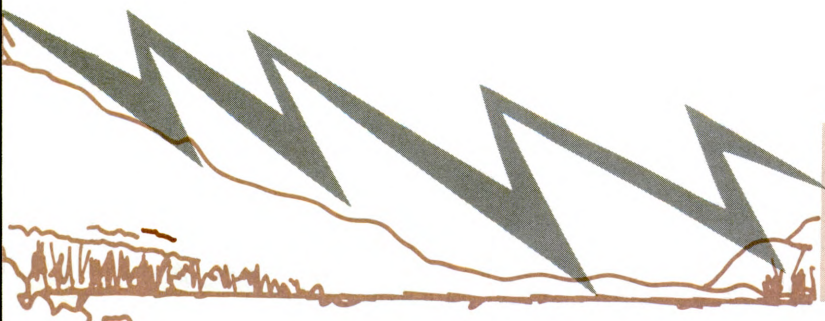
Radio-wire integration stations interconnect mobile radios to a switchboard. From there the routing goes to telephone subscribers.

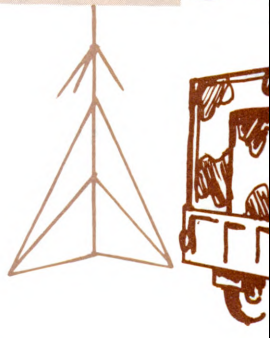
Main Features:

- Flexibility.
- Speed.

Strong Points:

- Emergency communications.
- Can connect widely separated facilities.
- Alternate routes.
- Initial communications.
- Effective during river crossing operations.



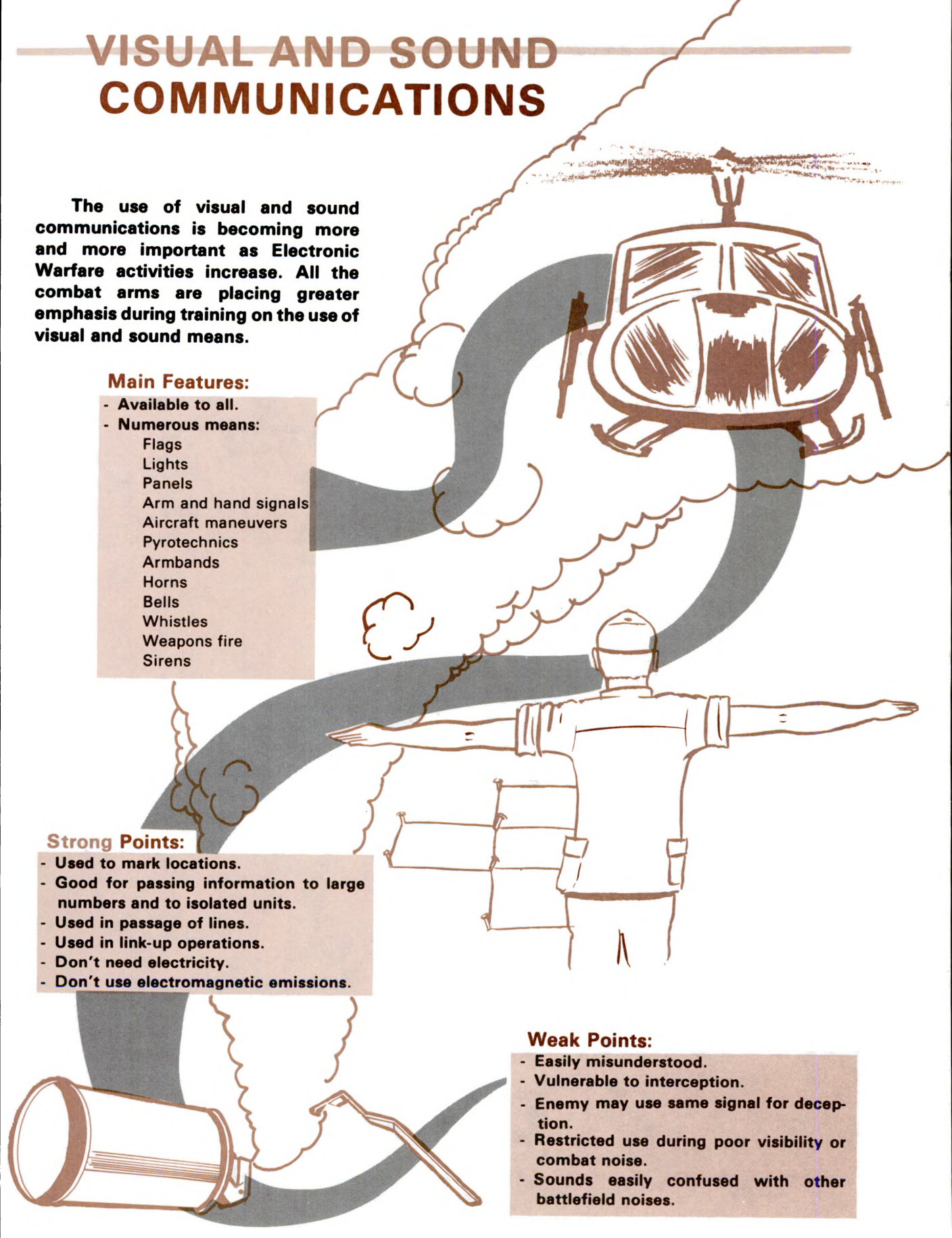


Weak Points:

- Can't be totally secured without loop security equipment.
- More vulnerable to jamming, inter- ception, and deception.
- Located on high ground.
- Uses high power.
- Combines conversations on radio and landlines.

VISUAL AND SOUND COMMUNICATIONS

The use of visual and sound communications is becoming more and more important as Electronic Warfare activities increase. All the combat arms are placing greater emphasis during training on the use of visual and sound means.



Main Features:

- Available to all.
- Numerous means:
  - Flags
  - Lights
  - Panels
  - Arm and hand signals
  - Aircraft maneuvers
  - Pyrotechnics
  - Armbands
  - Horns
  - Bells
  - Whistles
  - Weapons fire
  - Sirens

Strong Points:

- Used to mark locations.
- Good for passing information to large numbers and to isolated units.
- Used in passage of lines.
- Used in link-up operations.
- Don't need electricity.
- Don't use electromagnetic emissions.

Weak Points:

- Easily misunderstood.
- Vulnerable to interception.
- Enemy may use same signal for deception.
- Restricted use during poor visibility or combat noise.
- Sounds easily confused with other battlefield noises.

MESSENGER

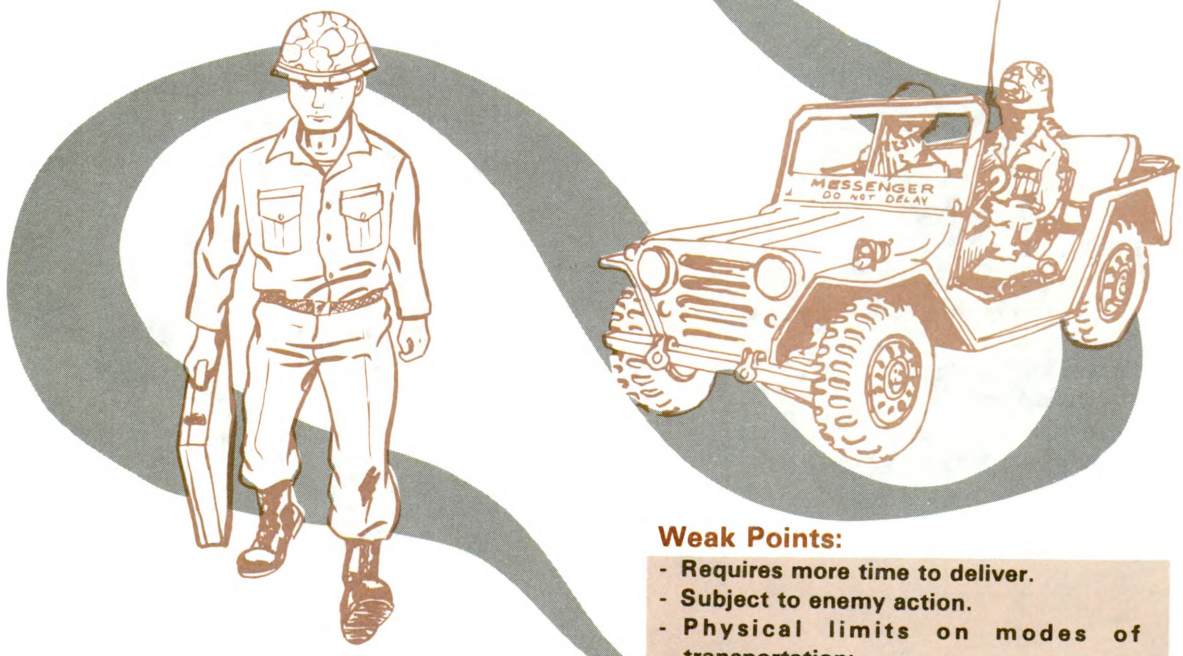
A messenger provides a method of sending and receiving documents by physical means. We must make greater use of messengers when it's practical, because of the increasing dangers in the electromagnetic environment.

Main Features:

- **Available to all units.**
- **Reliable.**
- **Flexible.**
- **Most secure means available to all units.**
- **Types:**
  - Scheduled messengers
  - Special messengers
- **Modes:**
  - Motor
  - Air
  - Foot

Strong Points:

- **Handles:**
  - Long messages
  - Large size maps
  - High volume routine messages
- **Very secure.**



Weak Points:

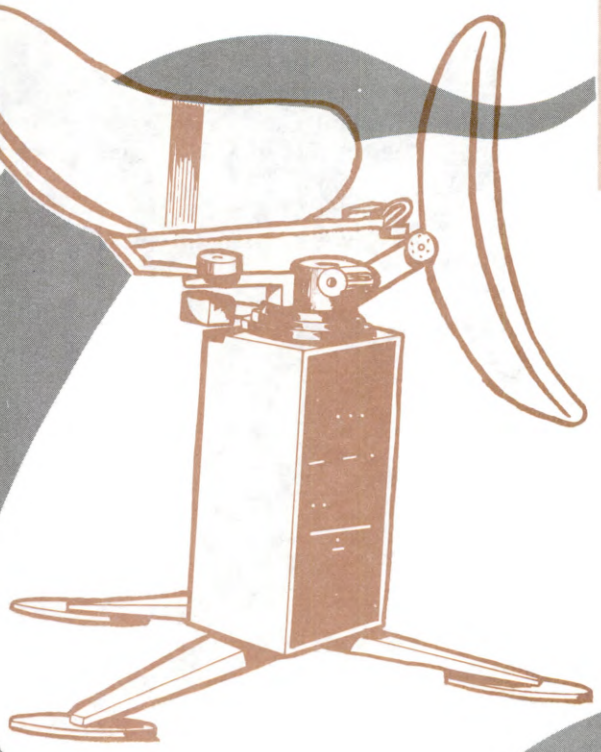
- **Requires more time to deliver.**
- **Subject to enemy action.**
- **Physical limits on modes of transportation:**
  - Weather
  - Terrain
- **Lack of person-to-person conversation.**

RADAR

Even though radar isn't a communications means, it does provide us with invaluable information about the enemy and assists our planes and ships with navigation. Radar provides a means of detecting the approach of enemy vehicles and personnel.

Main Features:

- **Equipment developed for:**
  - Short range ground surveillance.
  - Air traffic control and landing approach.
  - Locating hostile mortars and adjusting low velocity artillery fire.
  - Air search for detecting aircraft.
  - Missile tracking.
- **Long range.**
- **Mobile or fixed equipment.**
- **High power output.**



Strong Points:

- **Early warning and detection.**
- **Identification friend or foe (IFF).**
- **Eyes in the dark.**
- **Navigation aids.**

Weak Points:

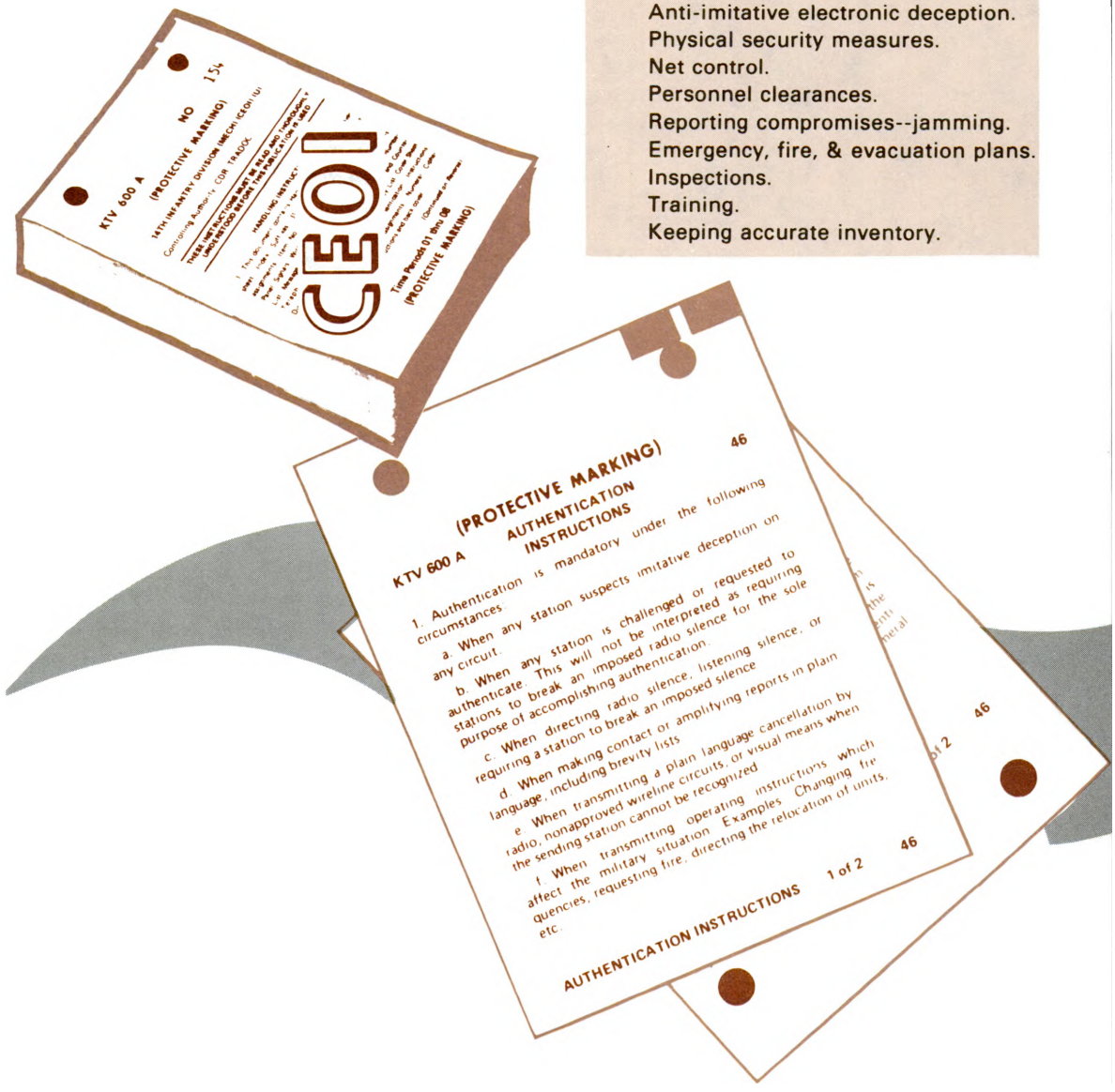
- **Complex maintenance.**
- **High and stable power requirements.**
- **Location is critical.**
- **Radar transmission characteristics identify type unit assigned to.**

SIGNAL SECURITY TECHNIQUES

Signal security techniques include all measures designed to deny the enemy information he could get from our communications-electronics. Although we are covering this section last, it is one of our most important areas of concern.

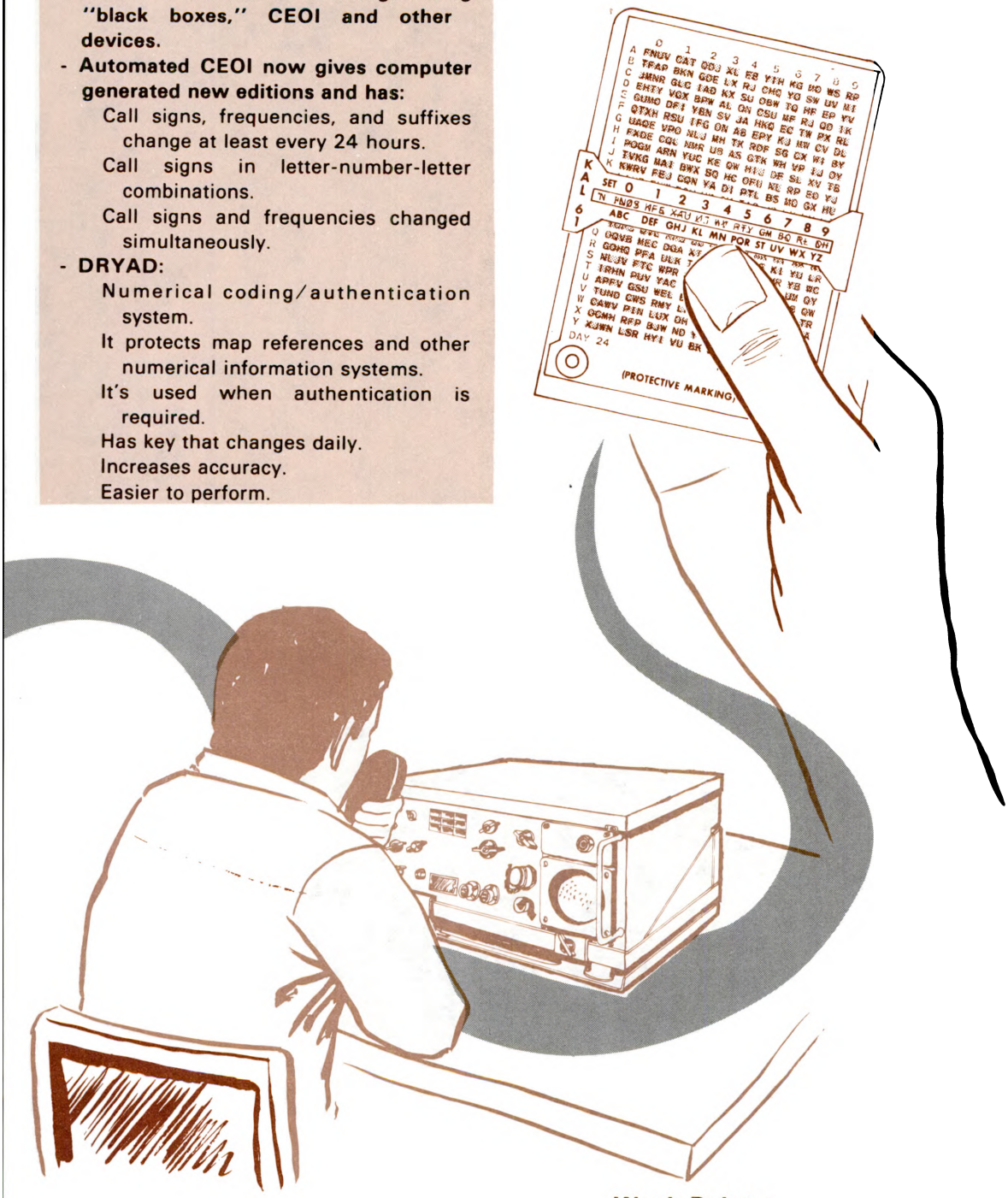
Main Features:

- **Communications security includes:**
  - Codes.
  - Ciphers.
  - Authentication systems.
  - Keying material.
  - CEOI.
  - Digital or analog encryption.
- **Operational security includes:**
  - Antijamming.
  - Anti-imitative electronic deception.
  - Physical security measures.
  - Net control.
  - Personnel clearances.
  - Reporting compromises--jamming.
  - Emergency, fire, & evacuation plans.
  - Inspections.
  - Training.
  - Keeping accurate inventory.



Strong Points:

- **Codes & authenticates messages using "black boxes," CEOI and other devices.**
- **Automated CEOI now gives computer generated new editions and has:**
  - Call signs, frequencies, and suffixes change at least every 24 hours.
  - Call signs in letter-number-letter combinations.
  - Call signs and frequencies changed simultaneously.
- **DRYAD:**
  - Numerical coding/authentication system.
  - It protects map references and other numerical information systems.
  - It's used when authentication is required.
  - Has key that changes daily.
  - Increases accuracy.
  - Easier to perform.



Weak Points:

- **Hard to insure discipline in using prescribed operating procedures.**
- **Compromises weaken the whole effort.**
- **Requires continued operations, training and emphasis.**

How is the Detailed Plan Developed?

Once you have considered the mission carefully, all you have to do is match the equipment to meet the requirements and you have a good plan. Well, it sounds simple, and it is, if you take it step by step. Now, we are going to go into a bit more detail and show you how a C-E officer would develop a good plan for a communications system. We are going to do this so you can get a feel for the steps that have to be a part of careful planning. It's just like the approach the successful boxer took in the beginning of the chapter.

The C-E officer in our example is familiar with the planning for tactical communications. His experience is a big help. In some situations, he has to rely almost completely on his experience and good judgment with only a little assistance from the standard publications. The procedures and data on electrical communications systems engineering are laid out in the TM 11-486 series of manuals. They can be helpful, even though they aren't entirely applicable to the tactical communications scene.

Our man knows that all communications planning starts with an Estimate of The Situation. A mental estimate or informal written estimate may be enough. At the higher echelons, where operations are large and complex, a formal, detailed estimate will probably be necessary. The C-E officer checks FM 101-5, Staff Organization and Procedure, and FM 24-16, Signal Orders, Records, and Reports, to refresh his memory on developing an estimate and a detailed plan. (See Appendixes C and D.) If he is at a higher echelon, he may have to brief the commander on the entire signal estimate. From here, he starts to work through each step that will lead him to a well developed plan. Let's briefly examine these steps.

● The Enemy--We won't be mentioning it with every step in the planning, but our man always keeps the enemy in mind. When he's

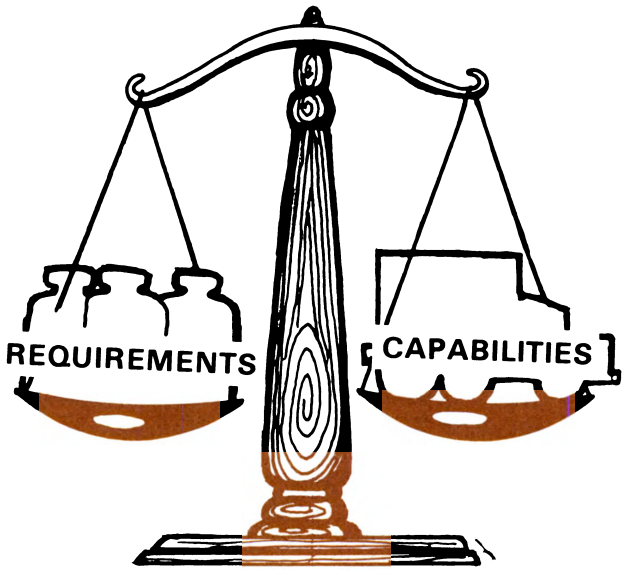
mapping out circuits and figuring out what equipment will do the best job, he's thinking about how the enemy can foul things up. When he's choosing the best locations for signal centers, he keeps an eye on the enemy location. He tries to pick locations where a natural obstacle will be between the antennas and the enemy. One sure thing, a successful fighter can't get so wrapped up in planning that he forgets about his opponent and why he is planning.

● Troop Lists--As one of the first steps in developing a plan, the C-E officer gets accurate and current troop lists that include the locations of the units and activities by grid coordinates. Usually, there will be separate lists for the combat troops and the support troops, so our man makes sure he has both. The troop lists will be a basic source of information, but they must be kept current or they'll be of little use.

● Equipment Lists--Our planner uses the equipment lists because they give an accurate inventory of the communications equipment that is available. The equipment that the unit has is based on the TOE or MTOE. However, the equipment lists give only what is on hand and keep our planner operating in the real world.

● Constant Planning Factors--When the C-E officer is working through his planning, he'll be working with some information that will be established beforehand and other information that will change with each operation. A few of the established items are the C-E troops and equipment available. There will also be an established guide for minimum communications, a list of communications priorities, and a base for circuit allocation. We'll see how the C-E officer uses each of these in developing the plan as we move along.

● Comparison of Requirements and Capabilities--The biggest step in the planning is matching what's required with what's available to do the job. Our C-E officer starts to move through the process of comparing and weighing the requirements against the capabilities. He must eventually determine whether or not all the requirements can be met. If they can't be met, either the requirements have to be cut back or we have to get more equipment and assistance to meet them.



Everyone involved in the planning, from the commander on down, has to keep economy in communications in mind when they're getting ready for the fight. First of all, if unnecessary requirements are placed on the communications system, some unit might not get all the essential support it needs. Second, if too much reliance is placed on nonessential communications, the enemy can gain valuable information on our whole operation, on everything from how much food is needed to how many wounded we have. Third and most significant, when the enemy decides to jam our radio communications and we're relying on it for everything, we can be left crippled on the battlefield. For the purposes of the planning that our C-E officer is doing in this example, we'll say that only the essential communications are being asked for, and that the planner is well aware of what the enemy will try to do to our communications.

● Guide For Minimum Communications- It may not be possible to furnish all the service that's requested by users, especially in the initial phase of an operation. When this is the case, some guide is needed to insure that there is a fair distribution of the essential support. This guide is one of the established items we mentioned. It has been called by such fancy names as "Minimum Allocation Criteria Standards." What it boils down to is that it's a guide for slicing up the communications pie fairly. This guide spells out what service will be provided to meet minimum requirements. The guide can't be so rigid that it ignores users who may have some sound justification for more or different communications services. For this reason, our C-E officer makes sure there are provisions made in the SOP, C-E annexes, and in the standing instructions to permit deviation from the standard guide, when it's justified.

● User Requirements--The C-E officer knows that specific requirements for telephone, teletypewriter, special facilities like facsimile and data, and messengers for each unit have to be established before decisions are made on how communications will be provided. Some units won't require organic communications because they will be attached to or will work with other larger units or installations. It will be up to these larger units to provide communications for attached units. They should see to it that their overall requirements are increased to reflect the extra load. The exact unit requirements are determined by taking the requested needs and checking them against the established allocation criteria. Our C-E officer should also make any necessary allowances for unusual or special situations. He will be using all the individual requirements in developing a "Requirements Density Overlay" which we'll get to shortly.

● Circuit Allocations--The circuit allocation lists are an SOP item that gives our C-E officer a great deal of the information he needs when he's planning. They reflect the need for specific numbers and types of circuits between command posts, signal centers, and echelons of command. They're another of the established items that are used in planning. At this stage in the planning, the C-E officer is getting more specific. He has gone from a look at the big picture to a consideration of the personnel and equipment available. He then checks the requirements against the capabilities. Now, he's getting down to assigning specific circuits to do the job. It's really a common sense way to get the job done.

● Communications Priorities--The priorities for assigning and, particularly, installing circuits are usually a well established item in any organization. Normally, they will be--

- ☐ **Command and Control Circuits**
- ☐ **Fire Support Circuits**
- ☐ **Intelligence Circuits**
- ☐ **Logistics Circuits**
- ☐ **Other Circuits**

When you're installing circuits and getting them operational, you want the most essential circuits working first. This is especially true if the facilities are limited and it becomes questionable if all circuit requirements can be fulfilled. There will be times when the priorities will change. During a lull in the fighting, a commander might give the intelligence circuits the highest priority. At that point, he's very interested in information on what the enemy is up to and what he can expect later on in the battle.

● Sole-User Circuits--This is one step in planning where our C-E officer might have to step on some toes. He has to provide a certain number of dedicated, sole-user circuits to insure effective command and control. However, the total number must be kept to a minimum. If it isn't, the efficiency and flexibility of the system will suffer. This means our C-E officer must say no to some people requesting sole-user circuits. It can't be an arbitrary decision, it's based on the

careful planning steps we've seen up till now. He weighs his decision by following the commander's guidance and by answering two major questions when assigning sole-user circuits:

☐ *Will the circuit carry information critical to the battle, such as command and control, fire control, and intelligence information?*

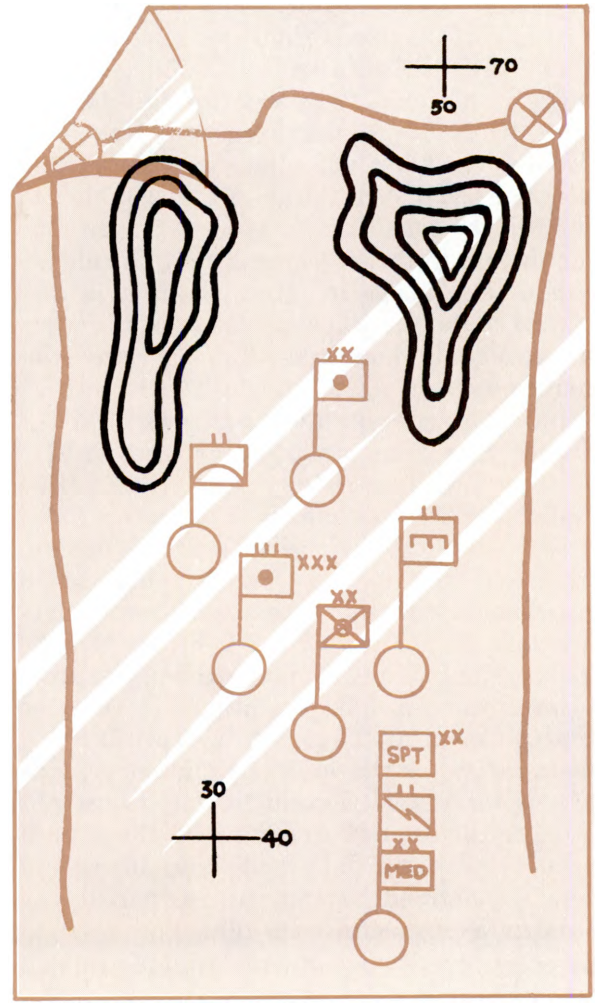
☐ *Will the circuit carry a high volume of traffic?*

Another thing our planner keeps in mind is that he doesn't want to route all the sole-user circuits over one path. If that path is disrupted, command and control could be seriously degraded.

● Common-User Circuits--Our C-E officer assigns common-user circuits for activities that don't need circuits full time and for those people who can't justify sole-user circuits. Here again, he knows it's important to make sure the whole system has a balanced number of common-user circuits. If a careful balance of sole-user and common-user circuits is established, the general communications plan will flow more smoothly.

● Alternate Routing--Our man knows that if he provides for the alternate routing of circuits in his planning, he'll have a system that has flexibility and survivability. He must have spare circuits he can use or some low priority circuits he can take over if he wants to provide alternate routes. At the division and corps echelons, the systems automatically provide a degree of flexibility, dispersion, and alternate routing. Our C-E officer knows that, at any echelon of command, alternate routing can be achieved. It's simply a matter of routing the circuits through signal centers common to both the originating and terminating centers and having spare circuits to fall back on.

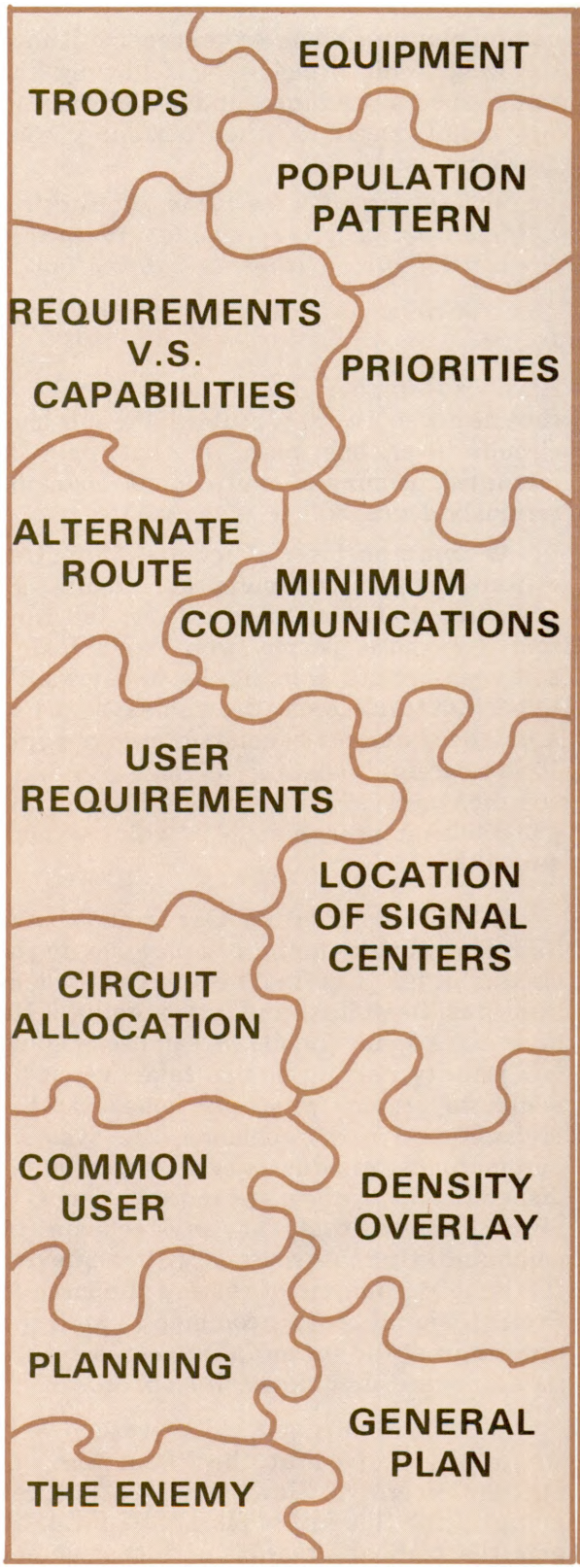
● A Requirements Density Overlay--Well we finally arrived at the "Requirements Density Overlay." How is our C-E officer going to use this in his planning? First, he gets the tactical situation map that shows where the units are and what the terrain is like. He makes sure it's large enough to permit an accurate look at the terrain. Then he starts to prepare a requirements density overlay. He lists the units that are in his area of responsibility by their grid coordinate locations. He normally finds these units listed in the operations order. He tackles one grid square at a time. He lists them in book form to make it easy to handle and file, and he only lists those units that require direct communications support. After he totals the circuit requirements for each 1,000-meter grid square, he posts the totals on a transparent map overlay in the appropriate squares. Now he's got a graphic picture of the requirements, the units that need support, and the terrain that must be dealt with.



● Population Patterns--One thing the density overlay reveals right away is where the people are who need communications. Our C-E officer sees some places on the map that have a large number of units and activities grouped in a small compact area. Other places have units scattered throughout an area. Our man is experienced enough to know that the type of activity the units are engaged in has a greater influence on requirements than just the number of troops in an area. For example, higher priority will be given to a major command headquarters than to a rear area support activity.

● Location of Signal Centers--Now that our officer has studied the requirements and completed the density overlay, he can select the general locations of signal centers. Some areas may require more than the capability of just one signal center. (For a more detailed discussion of signal centers see chapter 5.) In that case, our man usually subdivides the large area and assigns an area signal center to each one. Some other areas may have to be divided because of distance or terrain problems. This may have to be done, even though the resulting areas have a light load for their signal centers. One guiding rule our C-E officer keeps in mind, though, is that signal center facilities are designed to satisfy a variety of requirements, not any one requirement.

● The General Plan--All the work our C-E officer has done up till now goes into a General Communications Plan. (See Appendix D.) This plan will be refined and broken out into a detailed systems design. Finally, this process will come to a conclusion with the issuance of final orders based on the plan. Our C-E officer will be looking for two key things as the plan moves toward the final orders stage. He will be insisting that there are well-defined boundaries for the units that must provide the signal centers. Second, he'll try to see that the organizational integrity of the signal units is maintained. Definite boundaries and clearly defined areas of responsibility eliminate confusion and allow communications systems to be extended and readjusted smoothly and efficiently.



What's Involved in Site Planning?

We've followed the C-E officer who was involved in planning for a communications system. Now we're going to stick with a platoon leader and his platoon sergeant as they lay out the plans for a signal center. This will give us a chance to follow the steps in planning at a different echelon. The facts and circumstances will vary, but the process of planning uses the same simple and careful steps to achieve success at all echelons.

The final orders, based on the general communications plan, have been issued. In our example, the lieutenant, a platoon leader, has received orders to move his area signal center to another location. For our example, there will be time for a recon of the site, although this is not always possible on the battlefield. We'll join the lieutenant as he draws up the plans for his signal center's relocation.

● What are the major questions?--Our platoon leader is experienced enough to know you can't put your communications in just any location and expect to communicate and survive. In his planning, he'll be after the answers to:

☐Will this site provide the C-E that the commander requires?

☐Where do I put my communications gear so it will work?

☐How do I insure that my communications will survive the enemy threat?

☐Can my communications site be supported logistically?

If our platoon leader were going to set up a signal site to support a division or corps CP (a command signal center), he knows that a few extra considerations would have to be kept in mind. The commander wouldn't want the tall antennas and noisy generators in his immediate area. They'd make his CP a more easily located landmark for the enemy. There could be a problem with the distance between the CP and the site, because of the cable and wire lengths. Also, the radios can only be remoted so far from the user. To solve these problems, he would work through his company headquarters and S3 section who would give him a general location for his signal center. Then the platoon leader would pick a specific location that would be best for communicating.

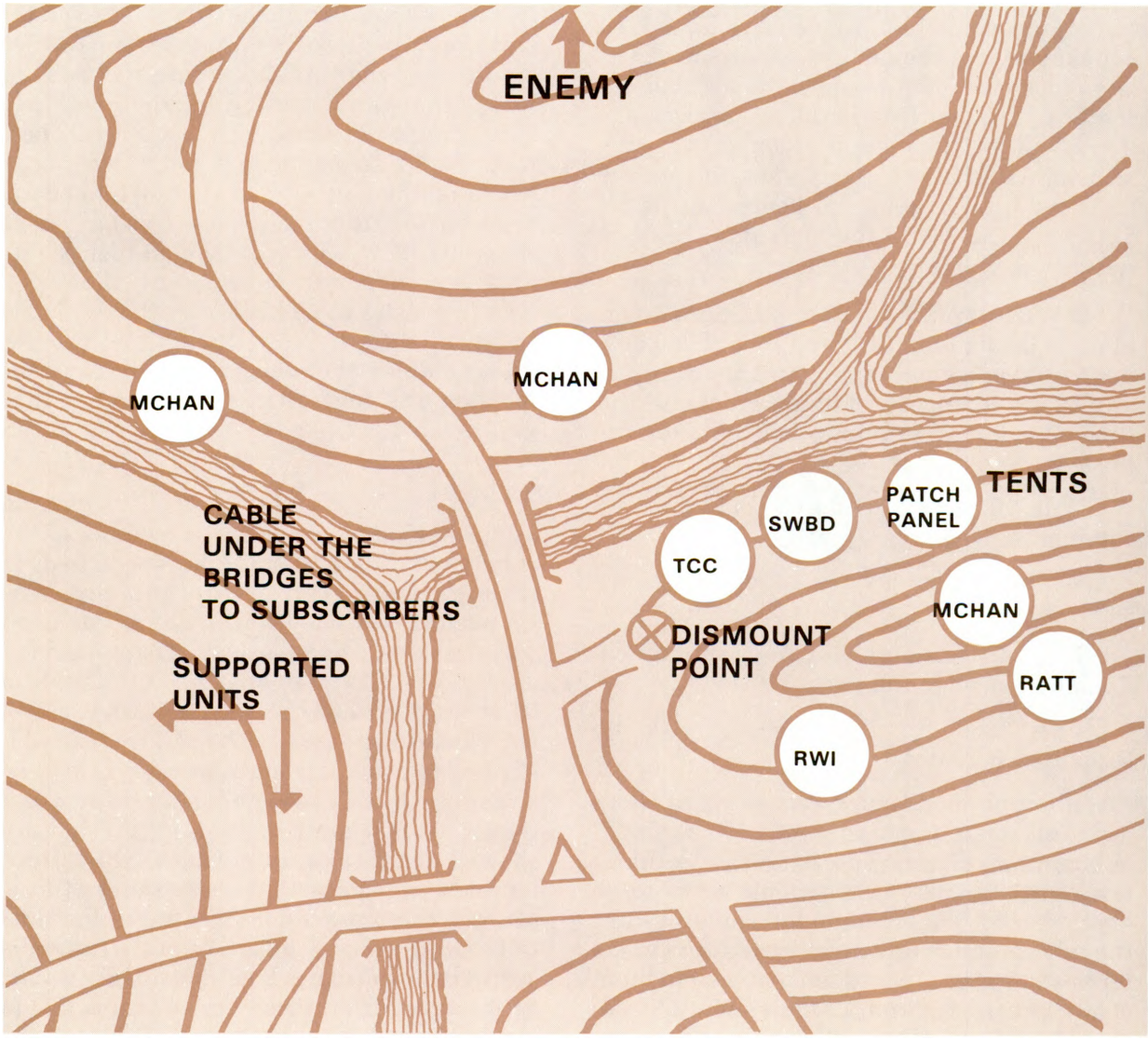
Our platoon leader doesn't have the problems of a command site in moving his area signal center, but he has other problems to consider. He meets with his platoon sergeant the first chance he gets. They want to make sure the equipment is in good shape and that any personnel problems are tackled before they pull up stakes and move. They look at the overall mission and their part in it. They check the terrain on the maps. Then, they make arrangements for a reconnaissance of the new site location. The general location of the signal center has been assigned. It will be up to the platoon leader and his sergeant to pinpoint the exact location of the site. This is why the recon trip is so important. They don't want to start moving down the road toward the new site location and find it's in a swamp when they get there.

● Recon of the site area.--The platoon leader has taken a ride to the location of the signal site. The first thing he wants to do is check the terrain in the area. The site must be accessible, relatively flat, and provide good overhead concealment from aerial observation. The platoon also must be able to leave the site when the word is given to move. He wants to be sure that he can leave in any kind of weather. He looks at such things as streams to be sure that he can cross them and frozen roads to see if he can travel if they are thawed out. He wants to look at the terrain between the site and the other end of line-of-sight communications. He takes the time to check the profile of the "shot." If there is any terrain blocking the line-of-sight shots, he'll report the need for a repeater to overcome the obstacles.

He quickly checks the distances on the map from his location to all the people he'll have to talk with. He wants to be sure he is within the range capabilities of the equipment. He is careful to look for the best antenna locations and plan for the correct orientation of the antennas. The antennas should be positioned so a hill mass is between them and the enemy, wherever it's possible. This decreases the enemy's ability to locate the communications site with his electronic devices. He also figures out where to put the generators and how to dig them in to cut down on the noise.

One of the most important things our site planner is looking for is a location that can be defended. After he's checked over the area for physical security, he studies the subscriber locations and the cable runs he must make. He also figures in any requirements for multichannel shots to subscribers that are too far away for cable.

Finally, the lieutenant takes time to stake the area to show where the equipment should go. Then he makes a site map and strip maps for the drivers to follow to the site. When this is done, it's back to the old site to get ready for the move.



● Planning for the move and setup.-After the platoon leader gets back to the old site, he hops to it. The sergeant checks on the equipment, personnel, POL, and the rations to make sure everything is ready for the move. The platoon leader works up a quick briefing on the site layout and convoy. He jots down a checklist of things to do after they arrive at the new site to make sure nothing is overlooked.

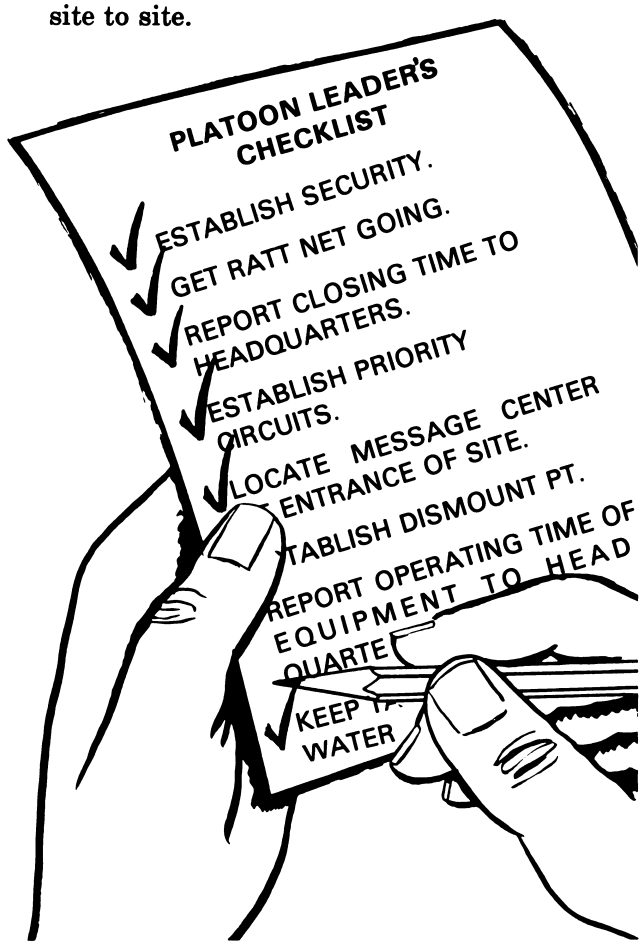
In the briefing, he wants to fill his people in on the site layout and any special problems that the new location might present. He will hand out the strip maps for the drivers to follow. He also wants to be sure his people keep the enemy in mind during the move, and that they know how to get a mechanic or a wrecker if they need one. He will stress the need for maximum use of camouflage and concealment. He wants everything to blend in with Mother Nature. In addition to any camouflage material issued, equipment should already be camouflage painted to help blend in with the terrain in the area of operations. He also doesn't want to see any fresh dirt thrown around or any cans or objects that can reflect the sun.

The platoon leader has seen the site area and knows it can be defended. Before his platoon moves, he draws up a site defense plan to be put into effect when they arrive at the new site. He's also picked a site location that can be supported logistically. He can't operate a site without POL, food, and ammunition. He will also need spare parts from time to time to keep things going.

When his people get to the new site location, the platoon leader wants everything to flow smoothly. He's pretty sure his equipment will operate well in the new spot. But as we've seen before, there are a lot of people making use of the electromagnetic environment. He could find out that there will be some frequencies that won't work. The atmosphere or interference from other facilities might be lousing them up. He might have to contact higher headquarters to have other frequencies assigned.

The platoon leaders checklist for setup at the new site reads like this:

You can see now that good planning results when a thorough and careful approach is used. This applies to a plan for a communications system, a plan for a signal center, and even an informal plan an operator uses when he moves his radio from site to site.

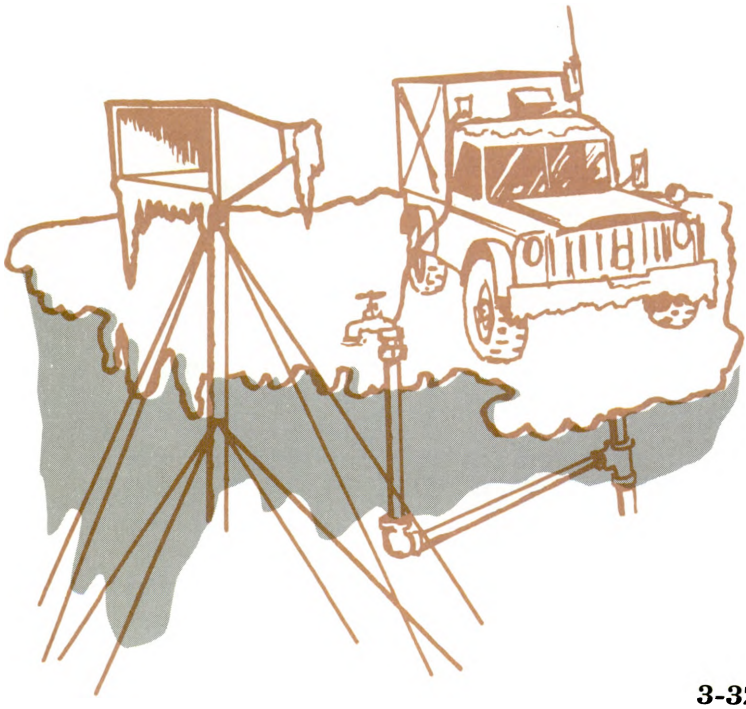


How do Special Environments Affect Communications?

We said in the beginning of this chapter that we'd talk about how different environments affect equipment and personnel. This is an extremely important consideration. The problems the environment can throw at us can be just as

effective at stopping communications as a direct hit from the enemy. We talked earlier about the need to consider the terrain and the weather when we're planning for communications. Now, we're going to discuss a few of the specific problems that come up in four special climatic environments and one very unique situation, a nuclear environment. We'll talk about Cold Weather, Desert, Jungle, and Mountain operations. Although we're going to talk about the extremes in each of these environments, every place on earth has a certain mix of the environments and their problems. We'll also hit the special problems of operating in a nuclear environment.

● **Cold Weather Operations**—For the most severe cold environment, special Arctic training is needed. Personnel must know how to install, operate, and maintain communications gear in the extreme cold. There will probably be more breakdowns in this environment, so spare parts must be handy. Arctic batteries and special equipment covers help keep the equipment on the air. However, the dry batteries must be kept warm and wet cell batteries must be highly charged. If personnel aren't vigilant, snow and ice can build up on the tents and the canvas on vehicles and tear the cloth. Fire is a big problem in cold weather. When people are trying hard to keep warm, they can get careless with heaters and open fires. Carbon monoxide poisoning is a constant danger to operators of C-E equipment, vehicles and generators. Constant alertness is required.



Two other problems are grounding the equipment and maintaining the generators. It's difficult, and sometimes almost impossible, to make a suitable ground because of the frozen turf. If we run into this problem, we might have to use a number of grounding rods, bury metal plates, or use existing underground pipes to get an adequate ground. In the cold, generators need antifreeze and lightweight oil to continue working and they are more prone to breaking down. Now, let's look at the ways the main means of communications are affected.

☐ **Radio**--We will probably rely on radio more than any other means if we're in cold weather operations, but there are a few things to keep in mind before we operate them. Moisture from the breath can freeze on the microphones and make them useless, so we must use mike covers. Power supplies have to be carefully watched, as we've indicated above. Ice on antennas can damage the elements and make it hard to crank the masts up or down. Sometimes it's nearly impossible to drive the stakes for guy wires into the frozen ground. High frequency (HF) radio performance is degraded or blacked out by magnetic storms and ionospheric disturbances. We'll depend on FM voice and multichannel radio more because ionospheric disturbances have less of an effect on them.

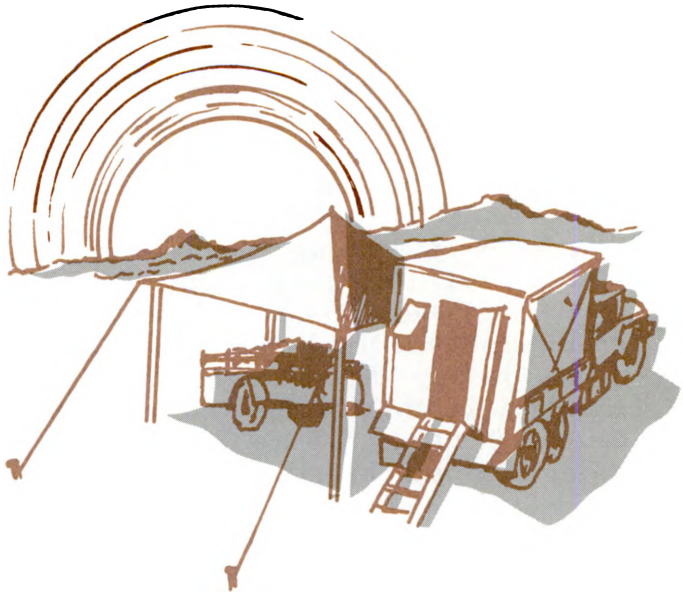
☐ **Wire**--We are forced to limit our use of wire communications to the local area in cold weather operations. It's too hazardous and takes too much time to try to install wire over any great distances in the extreme cold with poor traveling conditions. It's hazardous

trying to troubleshoot wire lines, too. In the cold, the wire is hard to unroll and ice on the connectors can cause a lot of trouble. When we do use wire, it must be kept off possible tracked vehicle routes. There are more tracked vehicles than ever and they can really tear up our wire.

☐ **Visual and Sound**--Visual communications are effective to pass the word. They're particularly effective in air-ground operations or when security requirements limit the use of our radios. Hand-and-arm signals, panel sets, and pyrotechnics are among the visual means we can use. But, we must remember that in cold weather, blowing snow, haze or ice fog can reduce the range and reliability of visual communications. Sound communications are particularly effective in still cold air because sound carries great distances. Yet, we must remember our communications security, because the enemy can hear sounds at great distances, too. Sound is always effective as a means for alerting and warning.

☐ **Messenger**--Messengers can be used for communications in any environment. They are reliable and secure, but lack speed. In extreme cold weather, this can be a problem. If messengers must be used, they should be dispatched in pairs. This may hurt if we're short on personnel, but in case of trouble, one messenger can help the other and get the message through.

● **Desert Operations**—Two of the biggest problems involved in desert operations are the extreme heat and the dust. The heat can take its toll on generators, wire, communications equipment, and personnel. The wind-driven dust and sand particles can damage all types of equipment. Grounding the equipment is difficult. We can usually get the job done by taking grounding plates, burying them in the sand, and pouring salt solutions into the sand. How are the different communications means affected in the desert?



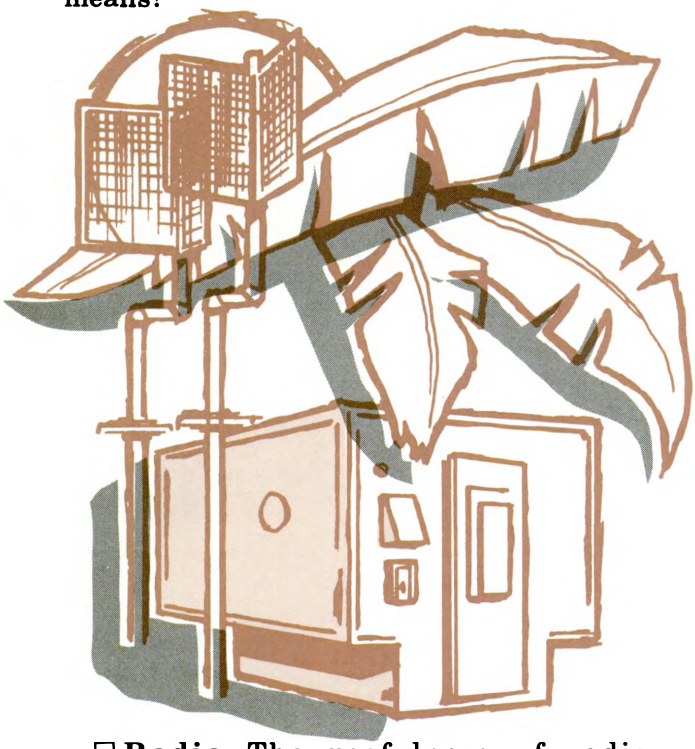
☐ **Radio**--Because of the fast-moving situation in desert operations, radio is used a great deal. In the flat areas where there aren't any obstacles to block transmission paths, communications security can be a big problem. Deserts can have extensive areas of rugged, hilly terrain. In these areas the ranges of our radios will be reduced. Radio gear, like most equipment, needs protection from the wind and dust and this, plus the heat, adds up to an increase in maintenance and logistics support.

☐ **Wire**--The increased battlefield mobility in the desert limits the use of wire communications. Another problem is that the vehicles moving around can cut the wire lines.

☐ **Visual and Sound**--In the desert, visual communications can sometimes be used over long distances. However, heat mirages and dust storms might limit visual communications. Sound can carry a long way on the desert where there aren't many obstacles to block it. It can be used most effectively for alerting and warning.

☐ **Messenger**--Foot messengers are impractical in the desert because of the heat and distance involved. When we need messengers, motor and air messengers will be most commonly used.

● **Jungle Operations**—During jungle operations, movement and visability are reduced by the terrain and heavy foliage. This same terrain and foliage provides us with excellent cover and concealment though. The big problems the jungle throws at the equipment are the humidity and the heat. Microphones, wires, cables, and gauges are especially hard hit by the moisture and fungus. Battery life is shortened, even in storage. It can be extended by storing the batteries in a cool, dry place, Good operator maintenance is the key to keeping the gear in shape in the jungle. If air conditioning is available, it is very effective against the high temperature and high humidity. What does the jungle do to different communications means?



☐ **Radio**--The usefulness of radio communications is reduced in jungle operations. VHF and UHF radios are particularly limited by the jungle growth and terrain that absorb and obstruct the transmissions. HF radio communications is more effective in the jungle. To conquer some of the problems, we might use airborne radio retransmission.

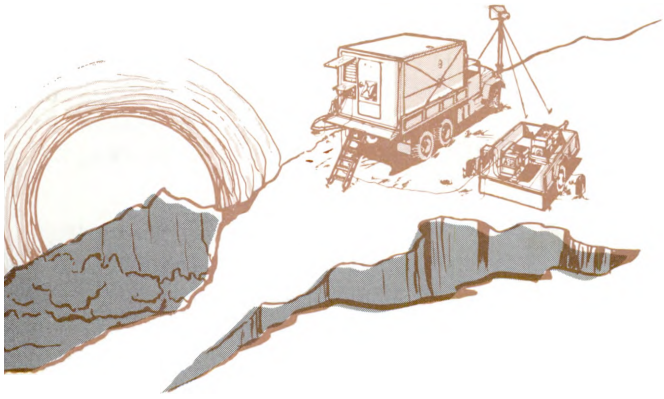
☐ **Wire**--The dense vegetation and terrain limit the use of wire in jungle operations. Aerial wire laying can be tried but the wire deteriorates because of the heat and humidity. Enemy infiltration is commonplace in a jungle environment. This reduces the security of wire communications because it can be easily tapped and monitored.

☐ **Visual and Sound**--Visual communications are very restricted in the jungle. We can use smoke or panels for ground-to-air signals, but these are about the only ways to use visual communications. The range of sound is cut down by the dense vegetation. We can only use sound on a limited basis for alerting and warning.

☐ **Messenger**--The use of motor and foot messengers is limited because there aren't many roads or trails. Air messengers can be used, but they can pinpoint CP locations for the enemy if they aren't used properly.

● **Mountain Operations**—Some of the problems we might run into in mountain operations are obvious. It's difficult to move around in the mountains and it's sometimes hard to find a level area for a communications site. Generators, in particular, need a level spot to operate properly. Some other problems aren't as obvious. Because of the rocky soil in most mountainous terrain, it's very hard to drive ground rods and guy wire stakes into the soil. The rocky soil also provides a poor electrical path for the ground rods, but we can add salt to the soil to improve the electrical flow. The altitude can cause carburetor problems with the generators, but the carburetors can be adjusted for the thin air. Let's see how mountain operations affect different communications means.

Radio--If we can set up a line-of-sight shot, we can continue to communicate in mountainous terrain. But a lot of times the terrain will restrict radio shots. If that's the case, ground-based or airborne repeaters might be needed to overcome the terrain obstacles.



☐**Wire**--As we've said, wire is one of the most reliable means of communications. In rugged mountains during the winter months, it is sometimes difficult to install and maintain. However, in the summer months, fewer problems exist. In the mountains, we will have fewer problems with tracked vehicles damaging our wire because we can place it off the vehicles' limited paths. We shouldn't have to bury or raise our wire overhead except where it crosses roads. The easiest way to cross the roads is to run the wire through culverts and under bridges, where they're available.

☐**Visual and Sound**--If we're trying to use visual communications from one mountain top to the next, will find a great increase in the range of the lights, mirrors, etc. Sound also carries a good distance. Yet with sound, the enemy can hear it too, and sometimes the echoes can distort the signal or message. In the mountain operation, as well as other operations, sound can still be used locally for alert and warning.

☐**Messenger**--Foot and motor messengers can be slowed by poor roads or terrain obstacles in mountainous areas. Air messenger can be used if there is a landing pad available. A lot of times, the wind and atmospheric conditions will prevent aircraft from coming into an area.

● **Nuclear Environment**--One of the realities of fighting on the modern battlefield is the presence of nuclear weapons. It's the US policy that nuclear weapons will be used only as a last resort or in retaliation for an enemy nuclear attack. Yet the possibility always exists that our people might be required to operate and fight in a nuclear environment. Nearly everyone is aware of the effects of the nuclear blast, heat, and radiation on personnel and equipment. There is another effect of a nuclear explosion that is not as well known, but could have a devastating impact on our communications equipment even great distances away from ground zero. This effect is the electromagnetic pulse (EMP).

EMP is a strong pulse of electromagnetic radiation, many times stronger than the static pulse generated by lightning. This pulse can enter communications equipment through antenna systems, power connections, and signal input connections. In the equipment, the pulse can break down circuit components such as transistors, diodes, and integrated circuits, melt insulation and dielectric material in capacitors, inductors, and transformers. This will cause an increased load on maintenance facilities and personnel. Well trained personnel are imperative to provide rapid alternate routing of damaged systems. Here, again, we can see the importance of developing and training with nonelectronic means of communications, because our electronic means could be lost.

Proper maintenance of equipment, particularly shielding, can greatly reduce the effects of EMP. Where gasketing is used around doors, vents, etc., good clean contact should be maintained. Cables with damaged shielding or connectors should be repaired or replaced. All access panels and other apertures should be closed at all times except when they must be removed for operation or maintenance. Where it's possible communications equipment may be buried with 18" or more of soil to reduce the effects of EMP. Effective grounding of equipment can help reduce the effects of EMP. Let's look at the way EMP hits different equipment and what can be done to minimize damage.

☐ **Radio Communications**--Single channel radio communications will be susceptible to EMP. The timing on disconnecting antenna and power cables is critical. Equipment, power, and antenna connectors should be disconnected when the radios are not in use or during periods of radio silence. Periods of radio silence must be imposed, particularly during friendly nuclear detonations.

☐ **Multichannel Radio Communications**--EMP will likely damage the sensitive receivers used for UHF multichannel communications. In order to minimize damage, all spare equipment should be disconnected from the antennas and the power and signal cables. Planning should stress flexibility of routing and rerouting of critical circuits. Allowance for spare equipment should be planned for to preclude the loss of entire systems.

☐ **Wire and Cable**--Nonshielded cable such as 26-pair cable is susceptible to arcing and dielectric failure. Replacement and repair are likely to be required after EMP exposure. Shielded cable will have a high survivability rate; however, frequent inspection of cable shield connectors is necessary to insure solid hookups. Cable loops should be minimized whenever possible and cable runs should be as short as possible. In addition, cable should be buried whenever practical.

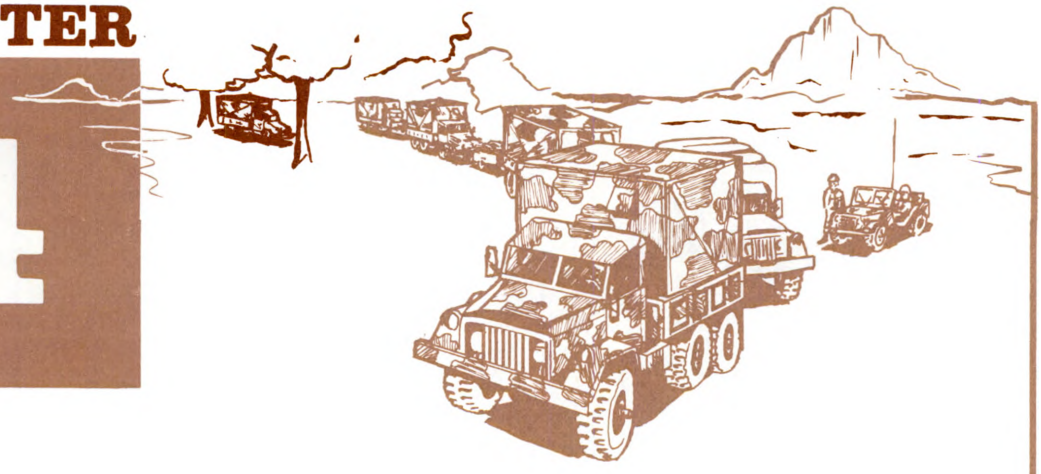
☐ **Visual and Sound**--If EMP causes the loss of radio and wire communications, the use of visual and sound signaling techniques may be necessary for command and control.

☐ **Messenger**--Extensive use of air, motor, and foot messengers may be necessary in a nuclear environment where equipment has been damaged by EMP.

Where Can You Find More Information on Special Environments?

In this book, we have just scratched the surface on some of the C-E problems in the extreme environments and how to overcome them. We want to get people thinking about all the things that can influence communications. One thing for sure, the weather, terrain, and nuclear environment can't be ignored by the communicator or anyone else on the battlefield. You can find a lot more detailed information about operations in special climatic environments in the FM 90-series "How to Fight" manuals. This series has entire manuals dedicated to Northern, Desert, Jungle, and Mountain Operations. Information on nuclear environments can be found in FM 21-40, a "How to Fight" manual on *Nuclear, Biological, and Chemical Defense.*

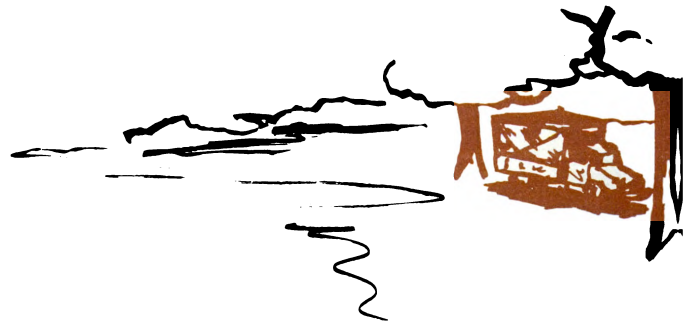
CHAPTER 4



Chapter 4. Moving to the Fight

- How do communications come into play in a move?
- What's happening in an assembly area?
- What's happening while we're on the move?
- What are the details of the threat to our communications?
- How do we use EW on the enemy?
- Why is an interference report important?
- What is Electromagnetic Compatibility (EMC)?
- How does communications come into play with combat intelligence?

Moving to the Fight



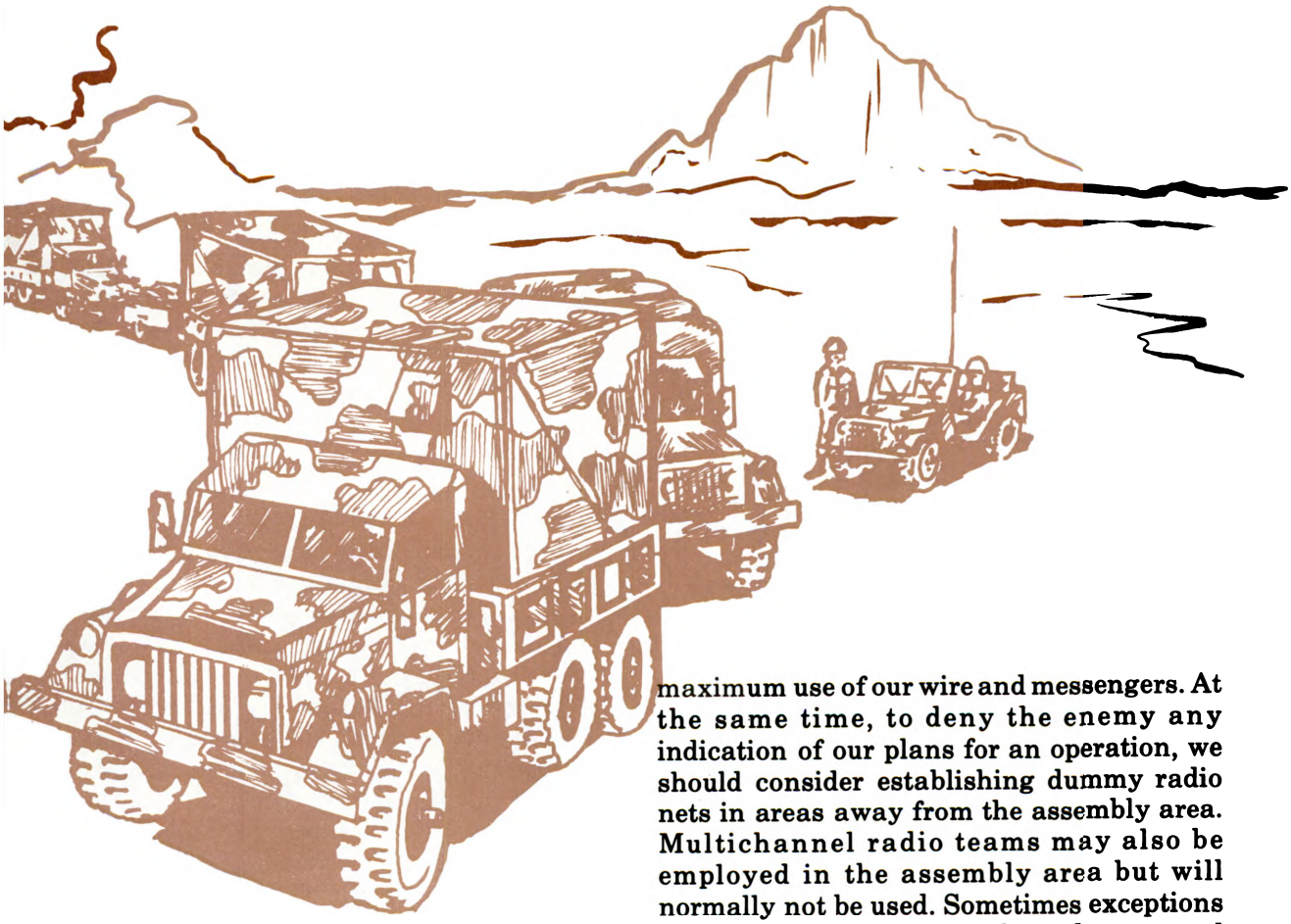
How Do Communications Come Into Play in a Move?

As we have emphasized in the first three chapters, to win on today's battlefield, we must always be prepared to move and fight and move again. We have shown how this calls for us to continually plan and prepare to outsmart the enemy. We know if we don't, we can't win. A key to winning on the modern battlefield is the ability to move fast and carefully. Difficulty involved in tactical moves depends, of course, on such things as the mission, terrain, weather, enemy activity, and the size of the force being moved. The keys to movement are reliable communications so we can maintain Command and Control and Communications (C^3). Whether we are in an assembly area, hiking down the road, or moving out smartly in tanks and trucks, we must have reliable communications and people who know how to use them. In this chapter, we'll look at the problems in tactical movements, communications in these movements, and the threat to our communications.

What's Happening in an Assembly Area?

The first step in moving to the battle is getting to an assembly area. Actions in the assembly area are very critical because this is our last chance to insure that we are 100 percent ready to fight. During this phase of movement, all echelons receive information on the upcoming operation. Plans are finalized and last minute supply and maintenance deficiencies are corrected. While all this is being accomplished, communications must go on. However, they must be kept to an absolute minimum to prevent enemy detection and the compromising of operational information. Remember, the enemy's signal intelligence effort is always cranked up and probably listening. If the enemy finds out what our plans are, he will hit us at the place of his choice and maximize our casualties and damage while he minimizes his own.

● Communications Means in an Assembly Area. -- Let's picture ourselves in the assembly area making last minute preparation for the battle. At this point, let's look into the communications means available to us. Signal centers are established and operated by the command responsible for the pending operation. Other centers may be established as needed; for example, at airfields, debarking points, and detrucking points. *Messenger* service will be available and, for security reasons, should be used as much as possible to satisfy communications requirements. Use of messengers will reduce our vulnerability to the enemy's EW and signal intelligence activities. If we can communicate without talking on those radios, the enemy cannot jam us or gather



information from our C-E devices. *Visual* and *Sound* signals are easily used in the assembly area. These can include arm and hand signals, vehicle horns, and smoke. These means are effective but we have to insure that everyone involved understands and keeps the meaning of the signals straight. Also, constant supervision of their use is necessary. We must also keep in mind that the enemy's eyes and ears -- as well as his electronic monitoring devices -- are always tuned in on what we are doing.

Our old standby, the *Radio,* is also available and handy in the assembly area. But let's see if we really want to use it. We are getting ready for the fight. We know the enemy is out there anticipating our next move. Let's allow him to anticipate, but never make it easy by getting on our radios and giving away information. You can bet that this will happen if we are not very careful. So, we must restrict the use of radios or silence them in the assembly area and make maximum use of our wire and messengers. At the same time, to deny the enemy any indication of our plans for an operation, we should consider establishing dummy radio nets in areas away from the assembly area. Multichannel radio teams may also be employed in the assembly area but will normally not be used. Sometimes exceptions are made and warning broadcasts and communications from reconnaissance forces in contact with the enemy are transmitted over the multichannel communications means. All radio sets should be serviced, tuned, and tested before we move into the assembly area. We should perform communications checks on frequencies other than those to be used during actual operations and any tuning and testing should be done with dummy antennas. This will further reduce the possibility of the enemy being on our frequency when we go into battle.

Wire provides another secure means of communications in the assembly area. However, we should not lay wire to just anyone who wants to talk. When we get the word to move out, we can't spend a lot of time reeling in field wire and cable. The use of wire helps reduce the electromagnetic signature and this can help us survive. As we mentioned earlier, we must be sure that the wire that is used is off the roads and paths of tracked vehicles. If this precaution is not taken, our wire won't be operational when we need it.

● C-E Coordination in an Assembly Area.—The time spent in the assembly area should be used to coordinate C-E matters and insure that we can communicate when the operation kicks off. As attached and supporting elements arrive, certain things have to be done. In our coordination, we should—

☐ Verify that all units have been assigned frequencies and call signs. If changes are required because of mutual interference, they should be coordinated with higher headquarters.

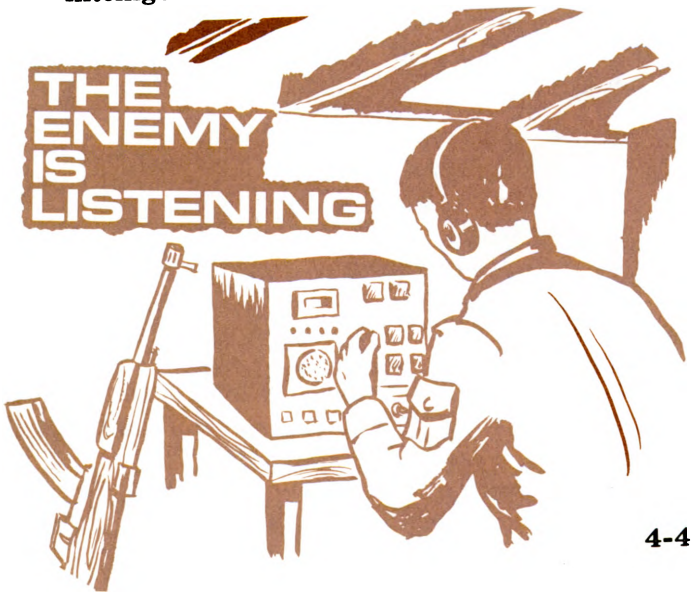
☐ Provide the ASA Tactical Support Element (ATSE) with a listing of restricted frequencies.

☐ Distribute CEOI extracts and brief personnel on C-E SOP matters. These include prearranged message codes and call signs.

☐ Verify status of C-E personnel and equipment. At this point, we can double check to insure that everything and everybody are where they are supposed to be. We should also verify the operational condition of C-E equipment in the area.

☐ Insure special C-E instructions for the coming operation are disseminated. These should cover any last minute changes not covered in the C-E annex or CEOI.

☐ Emphasize enemy EW and signal intelligence threat.



What's Happening While We're on the Move?

While we're on the move, command and control and communications become more critical as well as more difficult. At this point in the manual, we must ask ourselves some questions. What communications means can we use while on the move? What is the enemy threat to these communications? How do we counter this threat? How can we use EW in support of tactical operations?

We must have reliable communications while we're on the move for column control, for contact with reconnaissance and security elements, and to communicate with higher headquarters. Before we make a tactical movement, the C-E officer should receive a detailed briefing on the movement plans, so we can be assured of the communications for command and control. When it's practical, he will make a reconnaissance of the movement route to determine if radio relay or retransmission stations are needed to maintain continuous communications.

We must now look at the communications means that can be used on the move. Then we'll look in some detail at the other questions which we mentioned. Secure single channel radio -- FM and RATT -- is the primary means and provides the most rapid and effective means of controlling a unit on the move. Communications are instantaneous and response time is minimal. However, we must always keep the threat in mind. If we want to maintain operational security and surprise the enemy, we must minimize our radio communications. Technical analysis can identify specific radios, by small differences in electronic signature. If the radio has been associated with a unit, analysts will conclude that the unit is moving in the same direction as the radio. Detailed preplanning and coordination will eliminate the need for a lot of radio communications while on the move.

Messengers should be used to the maximum while we're moving. They can be used from front to rear and between adjacent units or columns. We will find motor

messengers operating from a mobile telecommunications or message center near the march command post. They can also be detailed to follow the force commander and designated staff vehicles. Messengers should be briefed in advance on the route of movement, on the location of the command post, and on any special vehicle markings. This will eliminate confusion and increase the communications efficiency.

Visual communications can come in handy while we are moving to the battle. The uses include transmitting prearranged messages, such as attack warnings, rapidly over short distances. Visual communications can also be used in recognizing and identifying friendly forces, such as friendly columns, specific vehicles, march command posts, and message drop and pickup points.

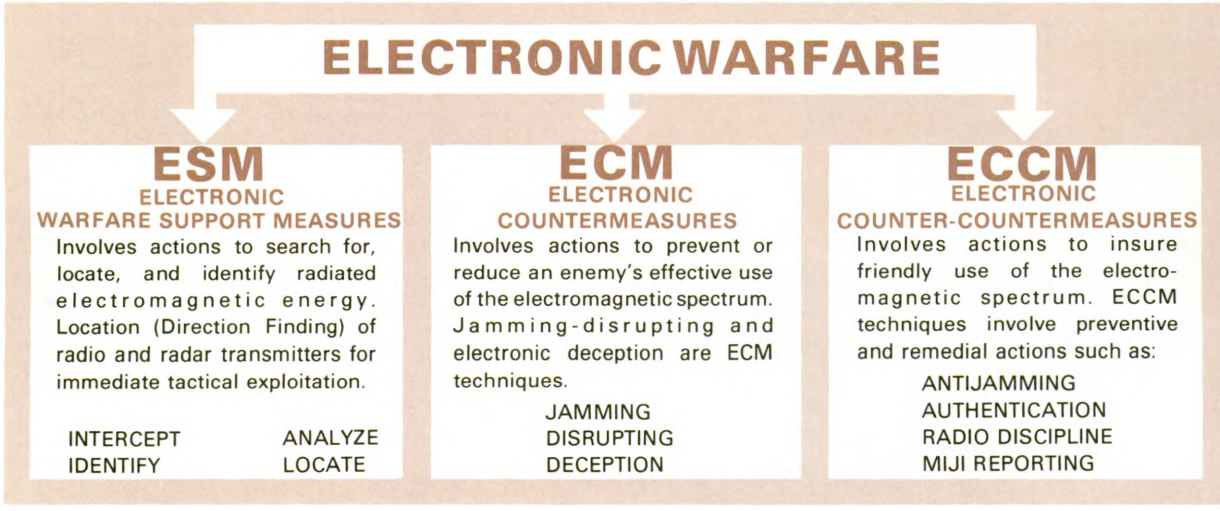
Visual means normally include flags, lights, panels, and arm-and-hand signals. These visual communications can keep us off our radios and reduce our vulnerability to the enemy's EW and signal intelligence activities. But, we must remember that visual communications are also vulnerable to interception and the enemy may use similar signals for deception and confusion. For example, if he finds out what the various colors of our smoke mean, he can employ the same colors and cause us to react at the wrong time and place.

Wire communications can be used very effectively by a combat unit moving to the front. When radio silence is established to maintain secrecy, wire can be used to establish checkpoints along the route of movement. These checkpoints can be manned either by military police or personnel of the moving unit. The checkpoints, tied together by wire communications, can report unit location and status while maintaining security and command and control.

What Are the Details of the Threat to Our Communications?

Now it's time to look at the threat to our communications. The threat is always there. It becomes critical during the move and continues during and after the battle. There is always the danger of enemy ambush to the messenger or the danger of the enemy hearing sound communications. The enemy could see us when we use visual signals. But the greatest threat to our communications is in the area of electronic warfare. We are talking about the electromagnetic environment and the use of our electronic emitters for command and control. We'd better understand the threat and know what to do about it. When the enemy cranks up his direction finding (DF) equipment and locates us, he will hit us with artillery or jam us.

Imagine getting up one morning and finding out that none of your electronic devices are working properly. You find that all communications are so jammed up that you can't transmit or receive anything. You can't talk across the street, and radar scopes are so covered with clutter that they're useless. When you're not being jammed, you're being monitored or deceived. This is Electronic Warfare and it can happen to you during the next battle. All frequencies of the electromagnetic spectrum used for communications are vulnerable to EW activities. In the high frequency range, radio emitters can be jammed on a worldwide basis. In the very high frequency range, distances at which



intercept and jamming can take place vary and can extend up to 200 km. Our radio equipment in the VHF range -- although considered to be line-of-sight communications -- can be intercepted far beyond the horizon. Radiation paths in the UHF range are essentially line-of-sight. But we must remember that the transmitted energy does not travel in the form of a pencil beam. It moves through space in the form of a cone with its base broadening as the distance from the emitter increases. We can see that with a microwave link between two widely separated mountain tops, the enemy can intercept the communications miles from the intended receiver. So no matter what the frequency range or type of radio communications, we are vulnerable to EW.

Specifically, what is Electronic Warfare? EW is actions taken to prevent or reduce the enemy's effective use of the electromagnetic environment, and actions taken to insure our own effective use of radiated electromagnetic energy.

● Electronic Warfare Support Measures. -- Effective EW against our communications-electronics requires that the enemy have knowledge of equipment characteristics, capability, use and vulnerability to EW. For example, if he wants to hit our single channel FM communications, he would need to know the transmitting frequency range. He would also want to know how it's used--command and control, administrative and logistics or intelligence--and if it is vulnerable to EW based on type of modulation, siting, and power. This is what *Electronic Warfare Support Measures* provide. By monitoring our C-E activities, the enemy finds our transmission frequency, power output, and type of modulation of C-E equipment. When he evaluates this information along with the type traffic being passed, he knows very quickly what kind of unit you belong to, if our communications are for administrative or command and control purposes, the location of our emitters, and who operates in the radio nets. From this information, he determines the best methods to jam and deceive us. He can also lob indirect fire on our positions.

● Electronic Countermeasures. -- Now let's look at jamming and deception. The enemy can really hit us hard by blocking out the portion of the frequency spectrum which we are using. He uses his direction-finding equipment and intercepts our signal, then determines our approximate location. He then can jam us at his convenience. This is simply done by turning on a transmitter which overcomes or "captures" our receiver. This can neutralize our communications and radars if we don't know what to do. The enemy can also choose to randomly jam portions of our operating frequencies. This is annoying and can affect our command and control, but it can be handled by the use of Counter-Countermeasures which we will discuss later in this chapter.

The enemy will also try to deliberately transmit incorrect or misleading information over his own communications system in an attempt to deceive us on his plan of action. We call this *Manipulative Electronic Deception.* He can do this to make us think that an attack is coming at a different time or at a different place than the actual attack. Let's look at an example of how manipulative deception would work. A false radio net is established by the enemy. Messages indicating an offensive in a certain area are transmitted in a cipher which is sure to be broken. Telephone lines are also established by the enemy so we can intercept messages designed to reinforce the deception. As a result, two of our divisions are held in reserve in this area. The actual attack is in another area. Of course, we can apply the same types of manipulative deception on the enemy.

The enemy will also attempt to enter our communications system by imitating a friendly unit or station. He will try to give us erroneous information or instructions, or obtain information from us. This is called *Imitative Electronic Deception.* Picture this situation in Southeast Asia. A convoy requested an air strike on a suspected enemy position. A station in the air-to-ground net broke in, identified itself as that of the district chief in the area of the requested air strike, and said the troops there were friendly. The air strike was canceled and the convoy was ambushed. No operations code was used in requesting the air strike nor was authentication requested of the district chief. Later information showed that the district chief had not made the call. In another incident, a station announced: *"Hot food...How many bunkers...and how many men in each?"* One of the bunkers began to answer, but a guard in another bunker yelled: *"Don't answer! If this is the relief commander, he should know how many men and bunkers."* The station was not heard from again. These are only isolated cases, but many casualties can result from imitative electronic deception.

You may think it's difficult to make deception work, but that's not necessarily so. We can insure that it doesn't happen to us if we are always careful. We must never become lax and fail to stick to sound operating procedures. Deception will usually take place when:

- ☐ Circuit discipline is poor and operating procedures are lax and incorrect.
- ☐ Operators show peculiarities in operating procedures which are easily imitated.
- ☐ The number of stations in a net is large and changes frequently.
- ☐ Fast-moving situations are present, only radio is used and traffic is heavy.
- ☐ Authentication is not used.

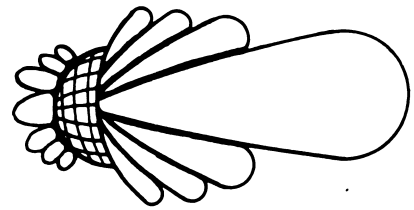
The techniques used to deceive us and our operators are practically unlimited. Let's consider just a few. An enemy may use the call sign of a friendly station to answer calls and accept traffic. If the friendly station fails to answer, the enemy station may accept and acknowledge the message. In this case, important traffic may not reach its intended receiver. The enemy operator may cause several stations to answer a call for priority traffic, then pretend not to hear the answer. By calling the friendly stations repeatedly, he can create confusion and delay authentic traffic. The transmission of false orders and instructions, especially at critical times during the battle, can lead to confusion and result in casualties. When we're operating under listening silence, the enemy may attempt to have stations break listening silence by falsely authenticating or using distress calls so he can locate our transmitters.

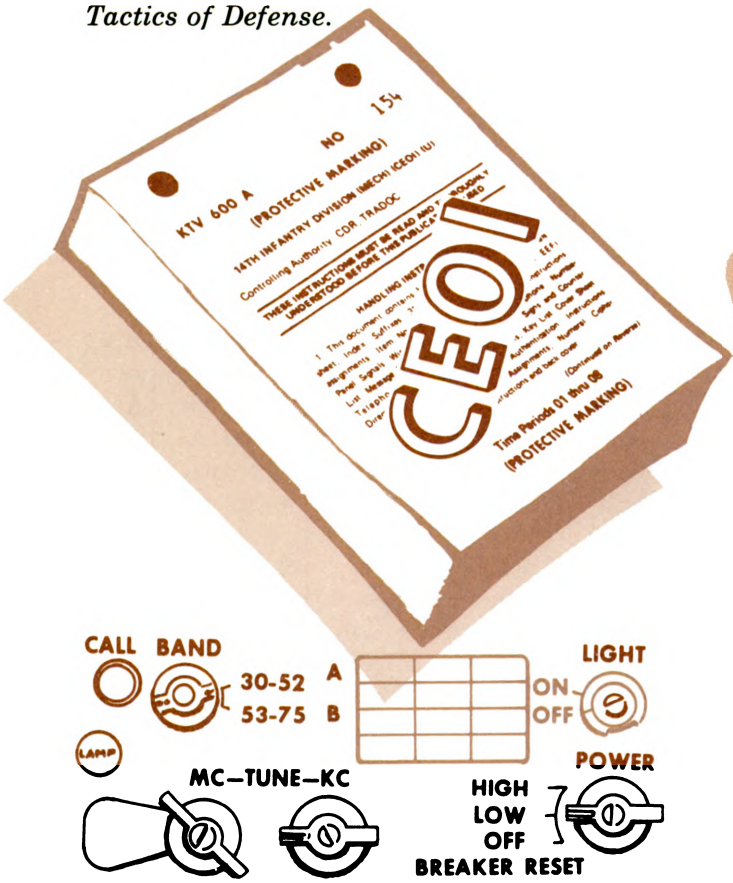
● Electronic Counter-Countermeasures (ECCM). -- We've talked about when the enemy will most likely try to deceive us and some examples of how he can deceive us. At this point, let's take a little time and see what we must do to counter his deception threat.

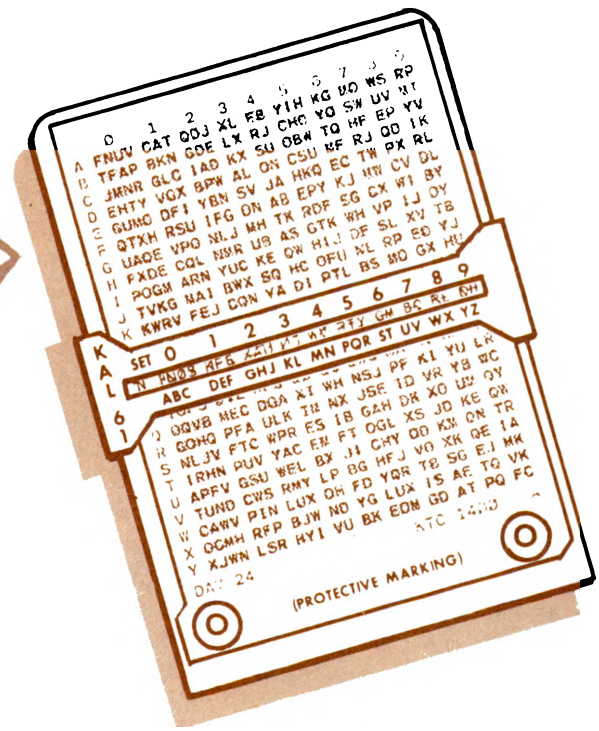
We call this *Electronic Counter-Countermeasures*. First of all, deception is just as hard to detect as jamming. We must also presume that the enemy can use deception at any time, therefore, we must always expect it. The first line of defense in fighting deception is the alert operator, and proper authentication procedures are by far the most effective tool against deception. Some additional measures which we must employ so we keep the enemy from deceiving us are:

- ☐ Proper use of operations codes, prosigns, prowords, and operating signals.
- ☐ Correct use of call signs and frequencies.
- ☐ Proper use of authentication procedures.
- ☐ Circuit discipline.
- ☐ Radio listening silence.
- ☐ Transmission security.
- ☐ The proper siting of antennas to reduce the chance of detection and interception.

More information on ECCM can be found in FM 32-30, *Electronic Warfare-Tactics of Defense.*







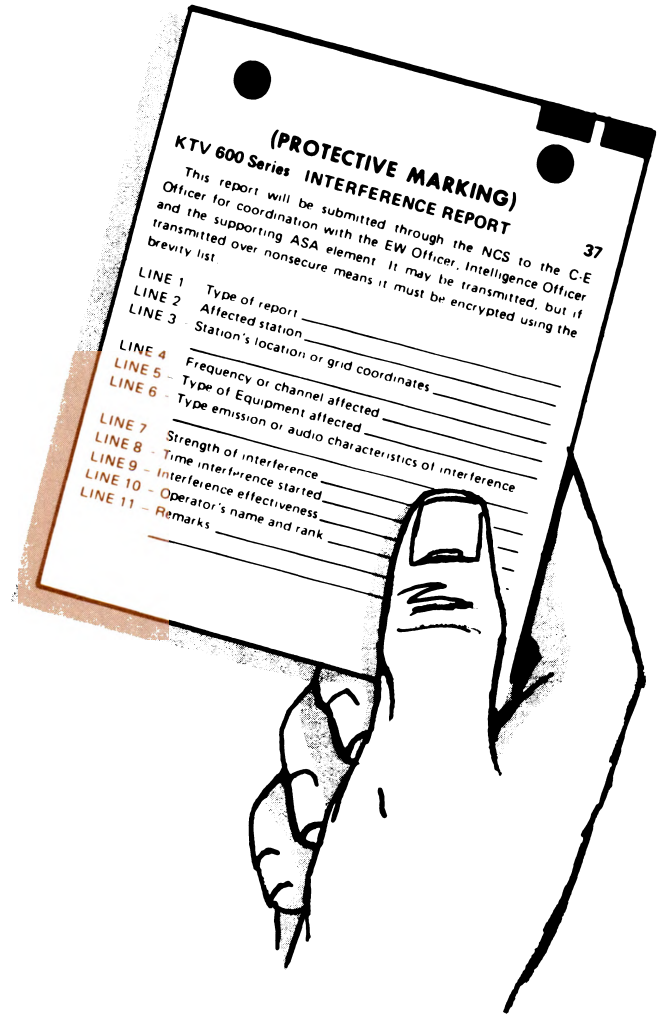
How Do We Use EW on the Enemy?

We have discussed the Electronic Warfare threat and how it can be countered. We must go one important step further and talk briefly about how we can use EW in support of tactical operations. The vulnerability of enemy communications can be exploited by us. Through the use of EW, we can suppress *his* communications and disrupt *his* command and control. EW support is normally provided by elements of the US Army Security Agency which can be found at the major headquarters down to and including division level and separate brigade. Details regarding US Army Security Agency support are contained in AR 10-122 and FM's of the 32-series. If you can't obtain ASA support, you can still throw EW at the enemy with organic resources. However, we have to be very careful and discourage independent action. A plan should be developed by the ASA Tactical Support Element (ATSE) in coordination with the G3 and C-E officer.

Why Is An Interference Report Important?

As we discussed earlier, we have to train our personnel to use communications principles and practices which will discourage the enemy's use of EW. We must also train our personnel to recognize and counter EW.

We must do one more important thing to insure that we win this electronic battle. This other step is *reporting* all suspected or known EW activities. Prompt, accurate, and complete reporting is a must if we want to get the overall picture and have a plan to counter the threat. As we concluded earlier, enemy EW is not a haphazard operation. It is a well-planned tactic and is most surely an integral part of his overall plan to defeat us. To give us the overall EW picture, personnel experiencing interference must immediately report the incident to their supervisor. Before forwarding the reports, a quick evaluation should be made to see if the interference might have been from adjacent equipment or caused by defective equipment. If interference is not locally generated, the information is sent through C-E channels to the C-E officer at the immediate headquarters. EW personnel and the C-E officer will act on your report. The next step is the preparation of a meaconing, interference, jamming, and intrusion (MIJI) report. Your CEOI tells how this will be prepared. We will not discuss the MIJI report, but you get the idea of what it's all about. Fast action in reporting can give us the jump on the enemy in the electromagnetic environment. (For further information on the interference and the MIJI reports, refer to Appendixes H and I.)



What is Electromagnetic Compatibility (EMC)?

Electromagnetic Compatibility is that much desired condition when all of our equipment--radios, radars, generators, vehicles (ignition systems, etc.)--operates without interfering with each other. When we have eliminated self-interference and do not interfere with the equipment of other friendly forces, we have achieved electromagnetic compatibility.

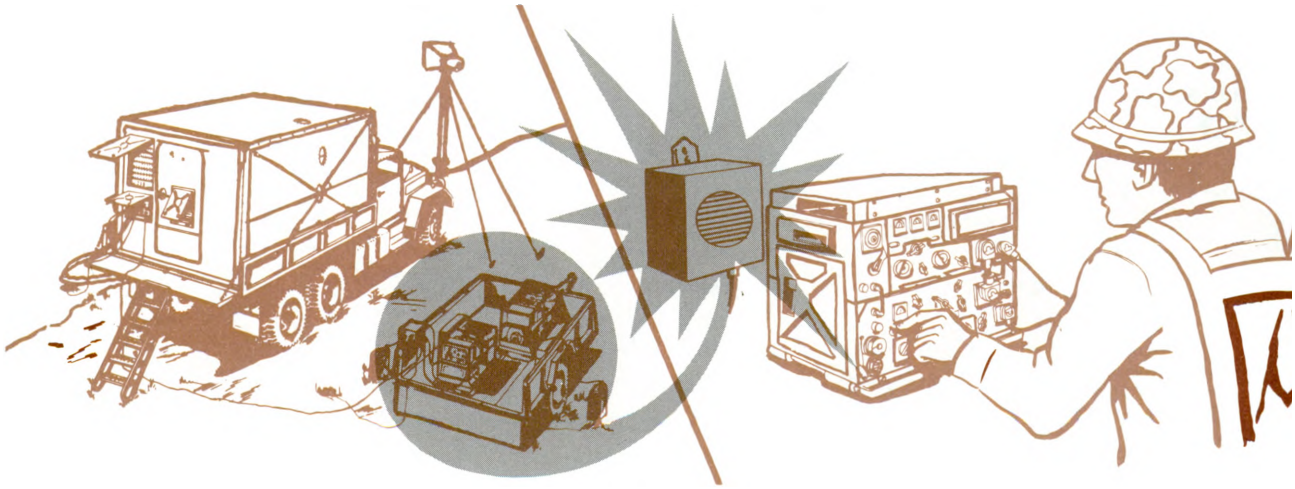
There are some sources of interference from natural sources—such as lightning, static bursts, and aurora borealis or northern lights—that we haven't learned to cope with yet. But there are factors, such as the location, proper operation, and frequency assignment of equipment, that help us to make sure we don't accidentally interfere with our own equipment. Some of the actions we can take are listed below.

● Moving the antenna on the equipment causing the problem. -- Most problems of local interference with radio and radar receivers can be solved by moving the receiving antenna away from the noise source, or vice versa. (If you have a small transistor radio, you can locate the noise source quickly and easily. Simply set the radio dial between stations and face the radio in various directions. The direction from which you receive the most noise leads to the noise source.) We can keep antennas oriented away from the prime sources of broadband noise. These sources include power lines, motors, generators, welders, and X-ray equipment.

● Proper Operation of Equipment. -- We can insure that all equipment is being correctly operated by using proper equipment controls, improving the ground systems, and by utilizing the directional properties of antennas. If operators make the proper use of gain controls, use the lowest power necessary for communications, use proper tune-up procedures, and correctly assemble and tune the antenna systems, we can avoid problems.

● Proper Frequency Assignment. -- We must have frequencies assigned to provide for adequate receiver-transmitter frequency separation for all equipment within our immediate area. Guidelines for frequency assignment can be found in the appropriate equipment technical manuals in the form of Frequency Interference Charts.

Our equipment is not designed to assist the enemy. Electromagnetic compatibility features are incorporated during its manufacture, and it's up to us to insure compatibility by knowing technical and proper operational characteristics, and by noting particular utilization characteristics whenever the equipment is operated. If we plan the layout of a command post or signal center, electromagnetic compatibility must be included in our plans. By following these common sense procedures, and adding to them, we won't unintentionally cripple our own communications.



How Does Communications Come Into Play With Combat Intelligence?

Through all of our operations, how do we stay one step ahead of the enemy? What enables us to hit him on the weak side when he's not expecting it? The answer is *Combat Intelligence.* This is one of the tools which the commander bases many decisions on, and one he cannot do without. How does the commander and his staff get this intelligence from their collection resources and use it in a timely manner? Through *Communications.* When that forward observer, that company commander, or anyone on the battlefield sees something they think is significant, they have to report it, fast and accurately, to somebody who can use it. This means timely reporting is a must. Normally, secure communications will be available up and down the line for intelligence operations, but sometimes the system takes too long. For example, we've spotted an enemy artillery position and find out through their communications that they'll fire on us in 5 minutes. We need to call counterbattery fire on them before they can hit us. We should always attempt to use a secure means but, in this case, we don't have time to send the intelligence through channels over secure means. This means that the information or intelligence is perishable and will be no good to us in a few minutes. In this situation, we don't care if the enemy knows that we know. We must report, even over nonsecure means, and blast that artillery. To sum it up, we must always have communications available for intelligence reporting. We must give priority to getting the word up and down the line so it can be used to our advantage in a timely manner. For additional information on communications dedicated to intelligence operations in the division and corps,see FM 11-50, *Combat Communications Within the Division,* and FM 11-92, *Combat Communications Within the Corps.*

CHAPTER 5

Chapter 5. Communicating During the Fight

- What is happening?
- Who is responsible for C-E in combat?
- How are communications organized to provide command and control?
- What is a signal center?
- How do we communicate during the offense?
- How do we communicate during the defense?
- How do we communicate during the retrograde movement?
- What are relief operations?
- What must we know about special operations?
- How do we communicate during river crossing operations?
- How do we communicate during air assault operations?
- How do we communicate during air defense artillery operations?
- How do we communicate during riverine operations?
- How do we communicate during night operations?
- How do we communicate during internal defense and development operations?
- How do we communicate during military operations in built-up areas?
- How do we communicate during amphibious operations?

Communicating During the Fight

What is Happening?

Where do we stand on this C-E road to combat? We've covered a lot of ground in this manual and have finally come to the real heart of the matter. Everything else has been leading up to the fight. Before we get into the details of how C-E fits into the fight, we want to quickly review some of the central points that have come out of the first four chapters. This will give us a little better perspective as we move ahead.

One of the biggest facts we've seen over and over is that our electronic emissions illuminate our well covered positions like flares floating overhead. We've seen this danger, but more importantly, we've seen how to minimize it. It doesn't take an expert to make us realize that to outperform and survive our foe, the simple common practices, such as short transmissions and authentication can make the difference.

We've seen that it takes command and control and communications to maneuver our forces. For today's soldier, we quickly recognize that command and control normally means some electronic shouting. It is also very apparent that the enemy now has *big* ears. Our *shouting* must be controlled if we are to survive. Yet, to maintain our rapid mobility, we just can't turn the electronics off. *What can you do?* Part of the answer is found in good training and planning. Training and planning plays the role of mediator, showing when we go from full electronic use to a condition of silence. It is clearly seen that, when our forces are trained and know our plans, many transmissions are eliminated, confidence is boosted, and our security is enforced.

We have covered EW, assets, training, and planning, but there is a little more to look at before moving on. After we've gotten the plan down pat, matched assets with requirements, and shielded ourselves with good signal security, we then looked into what it takes to move into the fight. Hitting the assembly area first, we checked out all the last minute details. We stressed again the importance of command and control and communications, covering in detail the electronic warfare threat, and especially what to do about it. We rolled out of the assembly area on our tactical move. At that point, we were armed, trained, and moving closer to the enemy. We saw, more than ever, the need to securely control the move as the gap closed between the enemy's forces and ours. This we can do, as was shown through sound procedures, nonradiating means, and knowing what to do.

This is where we stand on the C-E road to combat. We've come a long way, but we still have some very important ground to cover

before we get to the fight. We've got to understand the responsibilities of the C-E officer to provide the commander the communications which he requires and the organization of C-E for command and control. Then we can look at C-E in offense, defense, and retrograde operations, and C-E in special operations, such as airborne, air assault, and riverine, just to mention a few.

Who is Responsible for C-E in Combat?

The answer to that question is, of course, the commander. The commander is responsible for everything. But for our purpose here, we want to cover this responsibility in more detail. Getting into the nuts and bolts of who sees to it that the communications are there when they're needed. We want to pinpoint the communicator, see who he is, and what his organization looks like. So, in this section, we will take a look at the C-E staff officer of the major command and lower echelons. His responsibilities will be laid out in detail for your examination. From there the attention will be trained on the staff itself and its areas of responsibility. Because coordination determines the professional degree and success of a C-E staff, specific areas of interest will be high-lighted. This section makes a handy list of items to be considered by C-E personnel. In this section, there will be a shot at the peculiar situation of *"wearing two hats."* Many organizations utilize the C-E officer simultaneously as a staff man and commander of C-E troops. Those command responsibilities will also be identified. Since the responsibilities of the unit communications officer or the noncommissioned officer are so similar to that of the major command C-E officer, they will all be considered together here. Closing this section, we will look into who's responsible for C-E between different commands.

Putting the spotlight on these people will give us a better understanding of the responsibility and tasks of their positions. We have seen that keeping the commander in contact with his fighting elements is a difficult, complex, and vital job. It's a job which challenges and provides constant action. A closer look at who's responsible will show you that C-E is a 24-hour-a-day business, especially when we join the fight.

● "The" C-E officer. -- Starting at the top, the communications responsibility falls on the C-E staffs of the major commands. If you were assigned as "THE" C-E officer, you and your staff would advise the commander, his staff, and subordinate commanders on command-wide C-E matters. This advice covers a wide range of subjects. Some of the most frequently discussed are the use of secure equipment, CEOI's, controlling key

lists,remoting equipment, sole-user circuit allocations, FM radio use, maintenance of equipment, and, last but not least, training on all C-E matters throughout the command. Along with giving advice, you would be the man responsible for preparing such documents as signal estimates, operations plans, and orders for the guidance and direction of your subordinate commands and signal units.

You'd also be the man who exercises technical supervision over signal activities within the command. Examples of this technical supervision would include items from proper equipment grounding and antenna polarization to transmit levels on multiplexing and radio systems. By this supervision, you'd insure that communications operations are in accordance with the established technical standards and procedures which increase the quality of communications. In addition, you'd see to it that communications resources and support were adequate to meet your mission requirements. This may require combining equipments, committing spares, and requesting assistance from higher headquarters. Another part of your advisory role would be to monitor the status of organic communications resources in nonsignal units. *How many radios, secure devices, reels of cable, and wire do they have? What is their maintenance status?* The answer to these questions would help you to coordinate the entire communications picture of the unit for the commander. That's not all you'd get involved in either. Here are some other responsibilities the C-E officer may be tasked with:

☐Prepare electronic counter-countermeasure portion of the training program.

☐Plan still & motion-picture photographic services.

☐Coordinate frequency allocation, assignment, and handle interference problems.

☐Assist in preparation of EW plans.

☐Monitor and coordinate communications for weapons systems, combat surveillance, and target acquisition throughout the command.

☐Monitor and advise on status of communications security, data communications, and TACSATCOM.

● C-E staff. -- After reading through all of those duties, it's obvious you wouldn't be able to do it alone if you were the C-E officer. To assist the C-E officer in his monumental task, he is provided with a staff of specialists. This staff's organization and personnel structure will naturally vary in makeup according to the echelon of command it advises. Despite these organizational differences, the general responsibilities of all C-E staffs are basically the same. Here's what they look like:

☐*Headquarters* - directs activities of the C-E staff.

☐*Administration and personnel* - general administration of C-E staff.

☐*EW* - supervises evaluation of EW matters.

☐*Engineering* - supervises planning and installation of communications system.

☐*Frequency Allocation* - controls and issues frequencies, and handles frequency interference problems.

☐*Communications Operations* - prepares circuit diagrams and line route maps, VHF/UHF systems.

☐*Traffic* - prepares telephone/teletypewriter traffic diagrams and directories.

☐*Tactical Operations Center (TOC) Representation* - personnel to advise and assist.

● Staff Coordination. -- With so many varied subjects to keep tabs on (i.e., engineering systems and circuits, frequency allocation, communications operations) and C-E service requirements to provide, *coordination* becomes a key word. In carrying out its duties, the C-E staff must exercise *close* coordination with the other staff elements of the headquarters. This coordination must extend to all contacts the staff may have. Along with the other staff

elements of the command, the C-E staff needs to coordinate with C-E personnel of higher, subordinate, and lateral commands. They should get in as much face-to-face talking as time will allow. They should exchange information, find out what the other guy's problems are, let him know theirs.

Although they're sometimes forgotten, other key personnel must be kept informed of important C-E matters. For example, the C-E staff must always insure that the "general's aide" and the "colonel's driver" know how to use the CEOI, and how and when to change call signs and frequencies. If these types of personnel are not kept informed, embarrassing situations can develop and command and control and communications can be degraded. If they follow through with these ideas, they won't be found "dropping the ball" during the fight. Some specific areas of coordinating interest for the C-E staff are pictured here.

C-E STAFF COORDINATION

G(S)-1:

- personnel strength, replacements, and C-E requirements pertaining to personnel and administration.
- internal space, organization, arrangement, and operation of headquarters or CP, as well as their displacement and relocation.
- procurement and employment of indigenous labor for communications facilities.

G(S)-2:

- activities pertaining to enemy C-E activities and pictorial service as they apply to the tactical operation.
- planning, coordination, and supervision of COMSEC and SIGSEC throughout the command.
- employment of combat surveillance devices with respect to their impact on and relationship with the communications systems.
- Evaluation of MIJI reports and security violations.

G(S)-3:

- C-E aspects as they apply to the command's mission.
- employment of defense against weapons having impact on existing or planned communications facilities.
- selection and location of future CPs.
- preparation of orders.
- priorities for allocation of C-E assets.
- preparation of C-E training programs.

G(S)-4 and Support Command:

- procurement, storage, and distribution of C-E assets.
- priorities for maintenance or evacuation of C-E assets.

G(S)-5:

- acquisition and utilization of indigenous C-E resources.
- indigenous civilian C-E problems.
- international communications treaties.

ASA Tactical Support Element (ATSE):

- planning and evaluation of all matters relating to SIGINT AND ECM.

● "Two-Hatted" Role of C-E officer. -- Often the C-E officer will find himself assigned to two jobs at once or *"wearing two hats."* One hat is that of a commander of a signal unit and the other is the hat of the C-E staff officer of the major command to which the unit is assigned. The duties of the division signal officer are an example of this. Of the two jobs or duties, command is the most important. Many of the responsibilities and duties of the commander are inherent within the position and cannot be delegated. On the other hand, the duties of the C-E officer can be delegated. Both of the jobs are important; however, most of the C-E officers who get into difficulty do so because of command problems rather than C-E staff officer problems. The C-E officer must insure that his deputy C-E staff officer for the command is fully qualified to represent him in carrying out his duties. This will permit the C-E officer to maintain the proper balance of his duties as the commander and C-E staff officer. As the C-E staff officer, his responsibilities include the communications training and the personnel and equipment status for the entire command.

The other major concerns of the C-E officer are *installation, operation,* and *maintenance* of C-E systems, equipment and *security* of the systems and equipment. Let's look at these individually. The first step, of course, is *installation* of the C-E system. We have to get the commander's communications in as soon as possible, and we are always under tremendous pressure during the installation process. It's a race to unite individual equipments into a usable system, with circuits and nets for the unit's combat and support use. Personnel are on the move, positioning vehicles, siting antennas, stringing out wire and cable, and tying in the fighters to their leaders. You know there's a lot of work behind this if you monitor the activation, traffic, systems, and circuit status reports as they come in from all over the battlefield.

The *operation* of the system is the next concern. A unit's communications must be constantly available during the fighting. Displacements, phasing, and interfacing systems are a few of the ways used to follow the combat action. Behind the methods of keeping communications abreast of the action stands the unit's operations section and system control facilities. These facilities will be discussed in detail in the next section. Here we mention them to point out their job of planning, engineering, directing, and coordinating. Carrying out this responsibility requires monitoring the system, testing for quality, and routing circuits as conditions change. Here too, the combat orders are received, processed into C-E requirements, and passed to the operating elements for action. Actually covering the maneuvering units with readily available communications is a demanding, hectic, and complex responsibility.

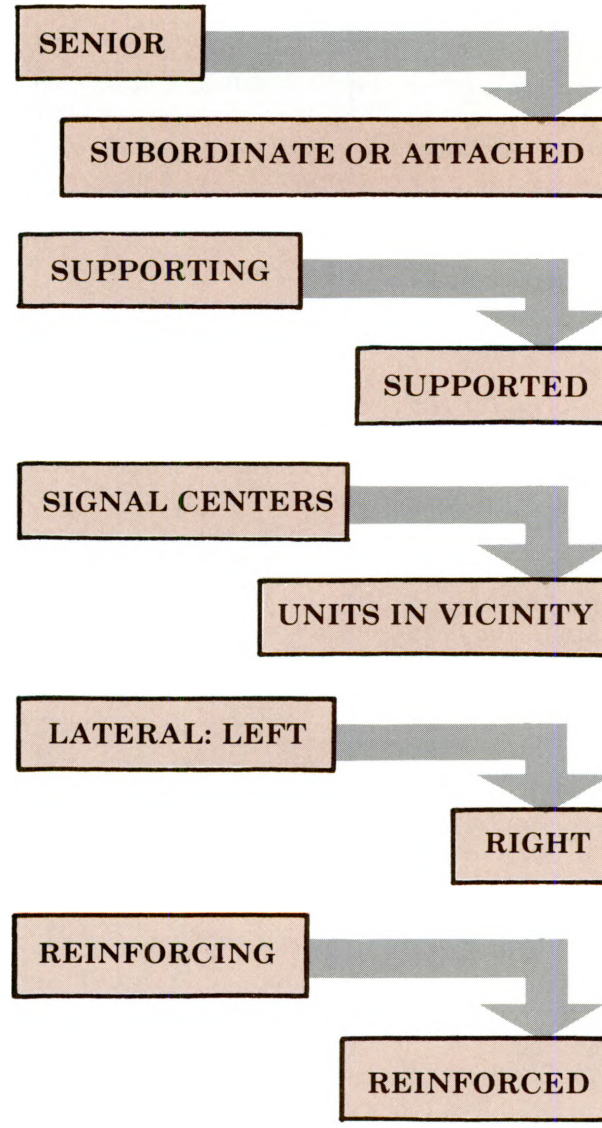
Another major area of responsibility for the commander is that of *maintenance.* The scope of maintenance stretches from the individual soldier cleaning his weapon or adjusting a power generator, to repair performed by trained technicians on complex radar gear. The principal task for the C-E officer within the maintenance arena will be one of insuring that the organization complies with established procedures for preventive maintenance operations. Now we won't identify all those procedures here, there are other manuals for that. What we will identify are some of the main points to follow in order to have a strong maintenance program. Here's what the C-E officer must insure: (1) That his personnel are well trained on the operations of their equipment, (2) that his personnel receive training in preventive maintenance of their equipment, (3) that sufficient time is allocated and tools available to perform the preventive maintenance, (4) that he gives priority and personal attention to the preventive maintenance program, and (5) that he knows the equipment and demonstrates his interest by personal supervision of maintenance operations, frequent informal inspections, and initiating on-the-spot corrective action.

A key concern of the C-E officer is the *security* of the C-E systems. This means both the physical security of the C-E systems, as well as the signal security (SIGSEC).

In summary, a dual-hatted C-E officer must be a commander, a staff officer, and also a technician. He must be able to juggle all three functions. His success as a commander depends on his ability to command his unit as well as the combat arms commander. He faces the same standard of excellence in a staff officer role and he faces the wrath of his commander if he is not a technician. These three main functions bring on other duties that include --

Advising
Supervising
Coordinating
Procuring
Training

● Responsibility of Providing C-E Between Commands. -- The senior unit is responsible for installing communications to supported or subordinate units. The responsibility of providing C-E between different commands was developed years ago when C-E equipment was more complex, from both an operational and maintenance standpoint. The equipment was larger in size and was not as mobile as today's C-E equipment. In many cases, the C-E equipment in today's Army in the supported or subordinate unit is exactly like the equipment in the supporting or senior unit. Therefore, the responsibility for *maintaining* communications can be assumed to be equal. It is an accepted fact that a subordinate or supported unit is expected to maintain continuous communications with its supporting or senior headquarters. The supporting or senior headquarters will take action to insure that adequate support is provided to the subordinate unit so communications can be maintained. Both elements are also responsible for taking immediate and aggressive action to restore any disrupted communications. If contact is lost, the first thing that both units must do is report the outage as soon as it's detected. Then those responsible on both ends can begin to work toward a solution. Here's a picture of the C-E responsibility relationships between different commands:



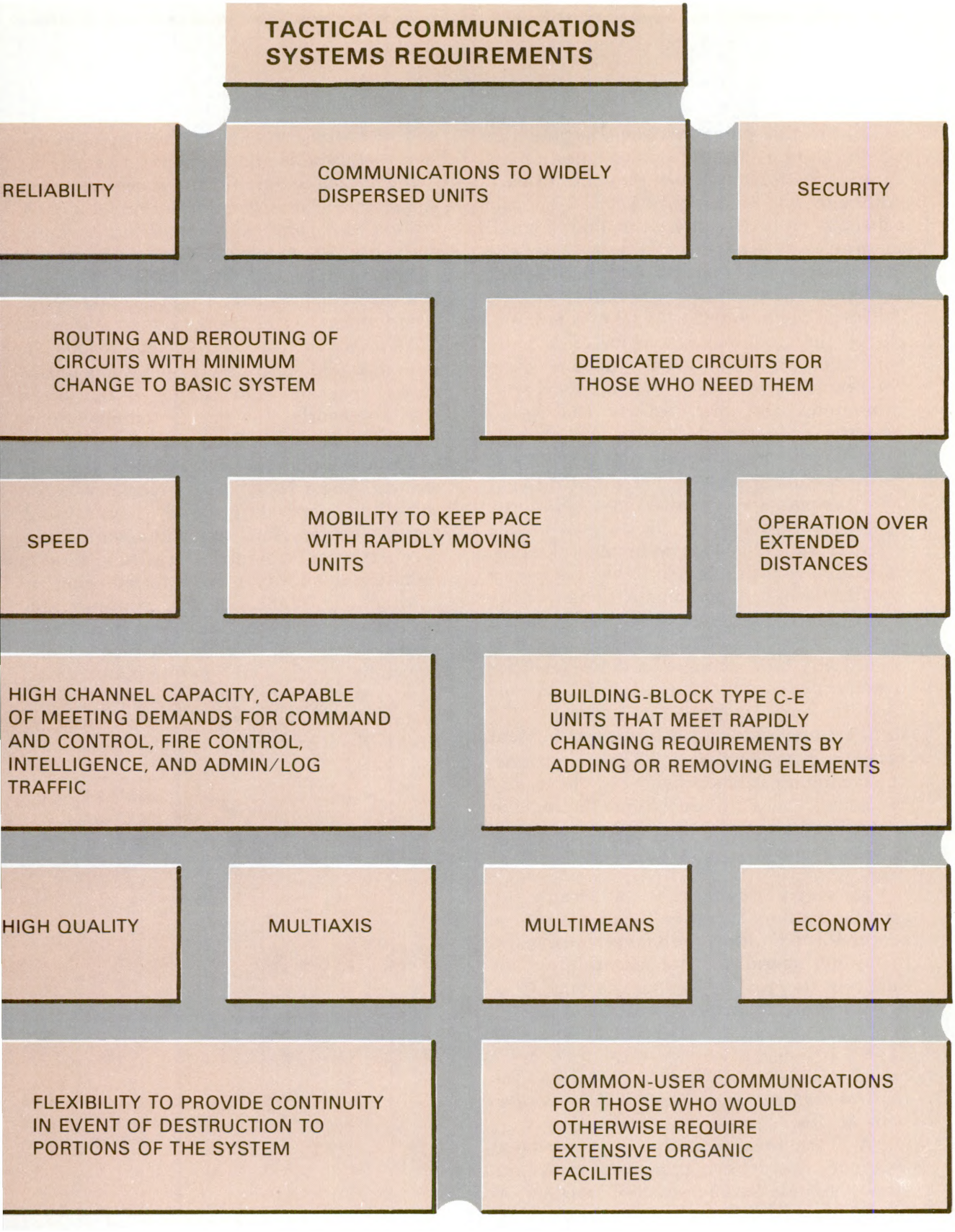
How Are Communications Organized to Provide Command and Control?

While we were discussing the responsibilities of the C-E officer, command and control came out as the reason behind what was done. In fact, throughout this manual we have stated over and over again the importance of this element. *Why is this subject given so much attention?* Many will say it seems obvious enough without all the extra emphasis. To fully appreciate what command and control entails, we must look beyond our first thoughts. There are other dynamic and subtle factors impacting upon this subject which increases in importance. It is not as simple as it first appears.

The Vietnam Conflict brought to light many new influences on our command and control function. Although Vietnam may be considered by many as unique for combat operations, the new experience gained there can be applied to possible future fights and is therefore valuable to us. The demand for communications was gigantic and never ending during the fighting. There was a tremendous emphasis on knowing what was going on every minute, not just by the troops and commanders in the field, but by the leaders of the countries involved, and by the families everywhere. Commanders not only had to keep up with the situation for combat action, but also had to brief the next higher headquarters on what was happening in order to tell an interested and news demanding world.

Still another aspect of this subject should be brought out. It's more subtle than those above, but it exerts a most significant influence on the subject. This is the *"STATE OF THE ART"* of our communications. With today's equipment, we can communicate with just about anyone, anywhere we wish. With special C-E equipment, people can talk to men on the moon or to the President visiting a foreign country. Back in Vietnam, this ability was exercised as never before. Interfacing, or the joining of different communications systems, became so common that the old distinction between tactical and fixed communications had to be dropped. It applied in other areas too. For example, the helicopter and the infantryman's radio sets, in both airborne and ground configurations, were integrated so successfully that new meaning was given to the phrase, command and control and communications. What all this shows is that if it's desired, command and control and communications can be exercised from the highest level, or from any intermediate point, right down to the lowest echelon of fighting. This new interfacing capability, coupled with the normal function of directing the fighting, is what makes command and control and communications so important when we join the fight.

Since we've discussed the importance of command and control and communications, our attention can now be directed toward its organization for fighting. Here we will describe how some major elements of C-E are organized to provide communications on an area basis. This is where the command and area systems will be described. We will also get into the function of the Communications Systems Control Element and the Communications Nodal Control Element. These elements, interlaced, make up the area communications system that provides the commanders with another means for command and control. The requirements that these elements are aiming to meet are listed here.



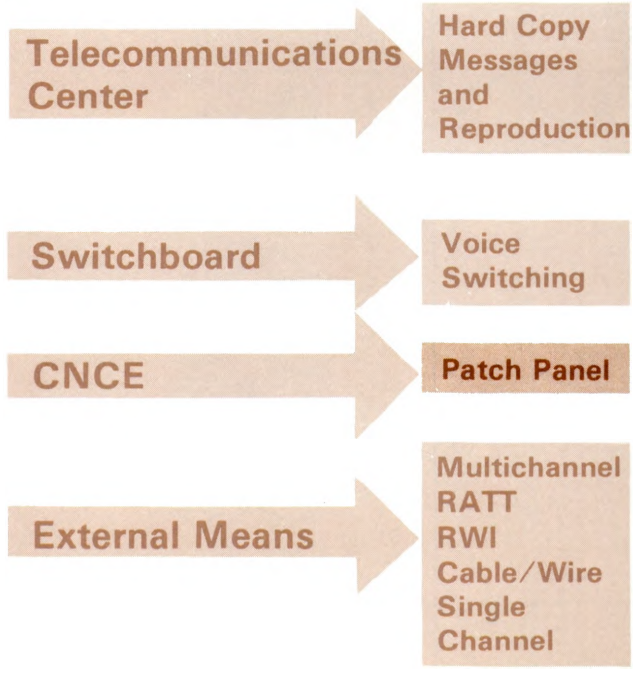
Up to this point, we have discussed in some detail the various means of communications and how they are utilized. Although we have not discussed specific echelons of command, we know small maneuver elements have austere communications systems and lightweight equipment because they are highly mobile. As we go further up the ladder of command, the communications system becomes more sophisticated. When we reach the rung where the brigade is located, we get involved with communications provided by the signal battalion.

We will not discuss how the single channel radios, such as FM and RATT, or wire systems are organized into nets to tie specific units together. The purpose of this manual is to let you know, in general terms, what C-E facilities are available. Let's start by discussing a communications facility found at brigade level. This is the signal center. Let's look at its purpose, how it is organized, how communications facilities are provided, and how these communications facilities are controlled. Although the location and size will differ to some extent between different types of Army Divisions, the communications provided are generally the same. Therefore, we will not distinguish between type units.

What is a Signal Center?

A signal center is a group of communications facilities that belong to a signal unit. The signal unit is responsible for installing, operating, and maintaining the facilities to provide communications to a command headquarters or units in a specific geographical area. A signal center is made up of a *Telecommunications Center, Switchboard,* a *Communications Nodal Control Element,* and *External Communications Means.*

A *Telecommunications Center* receives, transmits, and delivers paper copy messages via a signal communications means. A telecommunications center normally consists of a message center section, messengers, and terminals for transmitting and receiving messages. Other capabilities, such as facsimile and tape relay, can also be found in telecommunications centers. (See Appendix K for more information.) A signal center also has a *Switchboard* which manually or automatically interconnects telephone, data, or RWI circuits in response to a subscriber request. A signal center has a *Communications Nodal Control Element (CNCE)* that performs a variety of jobs. It manages and controls the operations of the signal center, coordinates with other CNCE's,reports to the Communications System Control Element (CSCE) on operational matters, and submits required reports. The CNCE also is responsible for installing, operating, and maintaining signal center facilities, interconnecting circuits on a semipermanent basis, monitoring quality of circuits entering or exiting the signal center, routing and rerouting circuits as required, and supervising closeout procedures. (See Appendix L). the *External Communications Means* that are in a signal center include multichannel (radio or cable), cable and wire, RATT, RWI, and single channel radio.

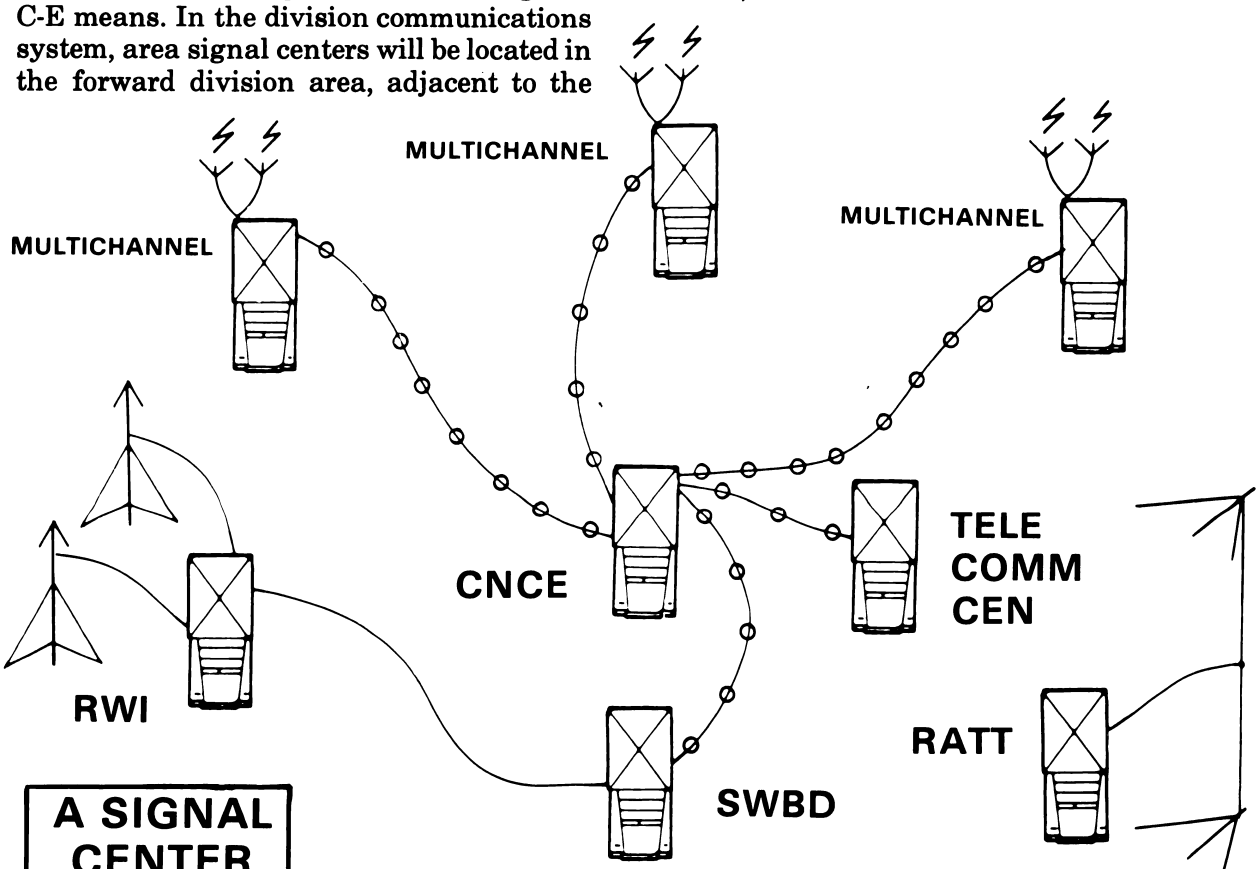


All signal centers perform the same functions and, for the most part, render the same services. But, you will run into two categories of signal centers to support you during the fight. These are Command Signal Centers and Area Signal Centers.

● Command Signal Center. -- As indicated by its name, the *Command Signal Center* is dedicated to providing communications to a specific command headquarters. It can provide communications to other units in the area, if enough facilities are available. In the division communications system, command signal centers are located at the division main, support command and division artillery. The command signal centers give the commander the backbone network for command and control of his subordinate headquarters.

● Area Signal Center. -- An *Area Signal Center* serves a geographical area. It is tasked to provide units located within an area facilities to supplement their organic C-E means. In the division communications system, area signal centers will be located in the forward division area, adjacent to the brigade trains area. The command and area signal centers are interconnected and form the backbone of a communications system.

At this point, we must remember that we are in the fight and that units are continually moving on the battlefield. Signal units are constantly planning for and conducting displacement along with the units for which they are providing command and control. Obviously, control of this C-E is very critical, and it's not a very easy task. *Who directs and controls these movements?* Let's zoom in on the control aspect for a few minutes, and look at the control elements which are essential in maintaining reliable communications out there on the battlefield. Of course, the signal battalion controls the signal centers which it has deployed. To exercise this control, it has one Communications System Control Element, or CSCE, normally located at main and, within each signal center, it has a Communications Nodal Control Element, or CNCE, as we said earlier.



A SIGNAL CENTER

● Communications System Control Element. -- The CSCE directs and controls the operations of the command and area signal centers on as near a real-time basis as possible. This timeliness is required to quickly respond on the rapidly changing battlefield. The CSCE has dedicated communications circuits to other control elements at higher and adjacent commands, and to the control elements at the subordinate command and area signal centers. The CSCE must:

☐ Allocate circuits to customers based on priorities.

☐ Plan traffic routes.

☐ Maintain adequate communications by increasing circuit allocation or rerouting established circuits.

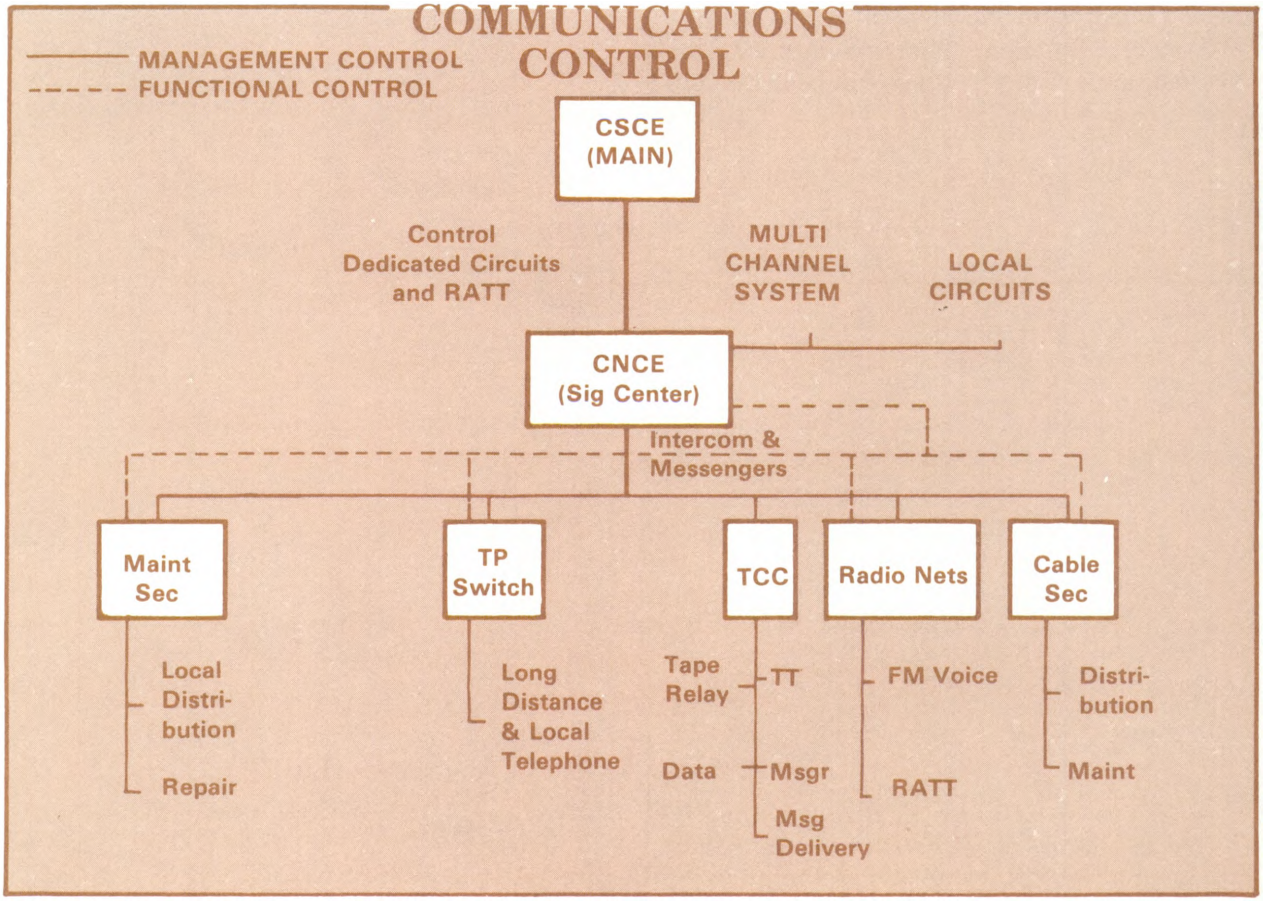
☐ Establish circuit restoration priorities.

☐ Develop system reconfigurations, to include signal center displacements.

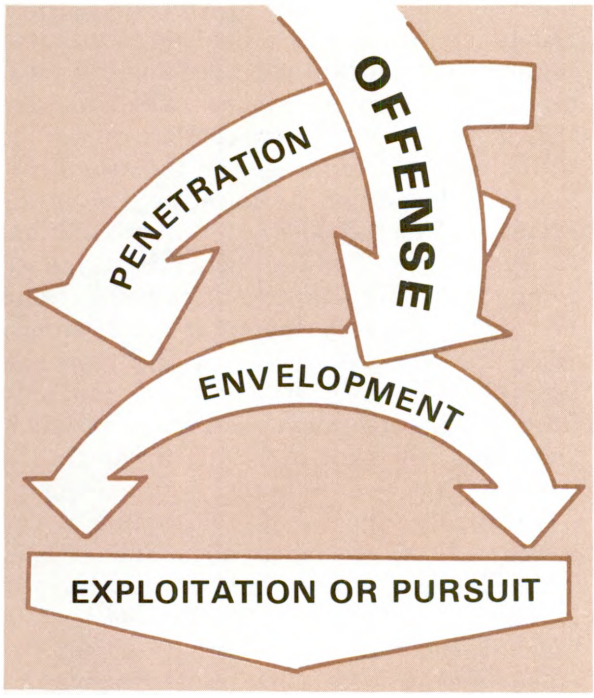
☐ Insure maintenance of accurate circuit records at subordinate control facilities.

☐ Supervise closeout procedures. (See Appendix L.)

The CSCE must be on top of the tactical situation at all times. It must be continually coordinating with its own headquarters as well as the combat units. This is necessary so it can plan ahead and give the commander communications at any location where his forces are fighting. When the commander moves, the signal center better be ready to move. The continual planning, the rerouting, the system and circuit restoring, and the displacing are some of the key functions of the communicators. The ability to win the fight depends heavily on them.



How Do We Communicate During the Offense?



Let's look at how communications fit into the three three basic tactical operations, *Offense, Defense,* and *Retrograde.* We'll cover the offense first.

In the offense, we take the initiative and carry the fight to the enemy. We attack to destroy the enemy or seize terrain, or both. The decision to go on the offensive must be carefully weighed and the probability of winning must be very high. This means that we must have good intelligence so we'll know where to concentrate our forces at the decisive time and place to beat the enemy. During the offense, we also have to make use of the terrain and deny the enemy a lucrative target. We must suppress the firepower of his direct and indirect fire weapons. This is done with our weapons systems as well as with the use of EW against his communications and fire control systems.

In the offensive, we try to pit our strength against an enemy weakness. In some situations, we mass our combat power against a narrow part of the enemy's defenses in order to break through quickly. We call this a *Penetration.* In other situations, we attack to avoid the enemy's main defensive positions. The purpose is to seize objectives which cut the enemy's escape route and to destroy him in position from the flank or rear. This is an *Envelopment.* We follow up every success to rout the enemy and destroy him. After the enemy's defenses are penetrated or his forces are enveloped, we follow by an *Exploitation* or *Pursuit.*

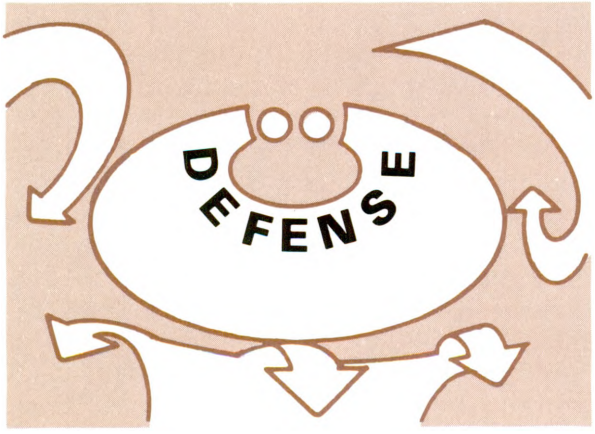
How do we provide communications for command and control of our fighters while they're out there on the battlefield in the offense? First of all, we know the commander must have responsive and reliable communications to take full advantage of mobility and to hit the enemy where it hurts the most. To accomplish this, the C-E plan must be closely coordinated with the operations plan so it will directly support the mission. Let's look at how our communications can be used in the penetration and envelopment.

● Communications in the Penetration. -- Signal centers are established by the major headquarters of the attacking force. They provide the C-E services which were discussed earlier in this chapter. They should be located as far forward as possible so they will be required to make only the minimum number of moves as the battle progresses. However, these facilities must be capable of displacing as the need arises. As we have already mentioned, CP's are likely to displace frequently on this fluid and mobile battlefield. Messengers can be used to great advantage during the attack, because of their inherent security and flexibility. However, speed of communications is important and the critical nature of a message will determine if it is sent via messenger. Visual and sound communications can be employed during the attack to transmit prearranged messages in accordance with the current CEOI. Secure radio is the primary means of communications during the attack. Prior to the attack, radio listening silence should be imposed so we can maintain surprise. But, once the attack is launched, this restriction can be removed. Throughout this manual, we have stressed the importance of keeping radios set to the lowest possible power to help prevent the enemy from locating us. Well,

when lead elements contact the enemy in the offensive, the enemy knows where they are. In this situation, its best to go to high power to insure that our communications are maintained and that we won't get overpowered by the enemy's transmitters. While we are in the attack, radio stations should maintain an even flow of traffic so the enemy will not be alerted of new or imminent changes in attack plans. Wire communications in the attack are secondary to radio as a means of communications. The minimum essential circuits are installed first, and the system is expanded as rapidly as possible to satisfy requirements. The time available, the rapidly changing tactical situation, and the supply of wire and wire personnel on hand will govern the extent that a wire system will be used.

● Communications in the Envelopment. -- In the envelopment, we avoid the enemy's main defense and reach for objectives to his rear by way of his flanks. In the envelopment, we communicate over longer distances. The distances involved can greatly tax our communications equipment and may require additional repeaters in the communications system. Planning for this requirement should be done far in advance due to the rapid moving situation. Because the need for speed and surprise is increased in an envelopment, radio listening silence will be required for a longer period of time. With this exception, communications are basically the same as in the penetration.

How Do We Communicate During the Defense?



A unit defends when it is attacked. The higher headquarters may order us to protect a locale, a line, an area, or a terrain feature. Defensive positions are held until the next higher headquarters approves a withdrawal or directs otherwise. Modern weapons give the defender sufficient combat power to inflict catastrophic losses on the attacker -- losses so large that he cannot continue the offensive. The defender fights on ground that he has chosen -- ground which is organized to maximize his weapon's effectiveness and minimize their vulnerability to enemy weapons. He also uses natural barriers, strengthened with obstacles and mines, to hamper enemy movement. He provides sufficient concentration of fires at the decisive time and place to stop the enemy.

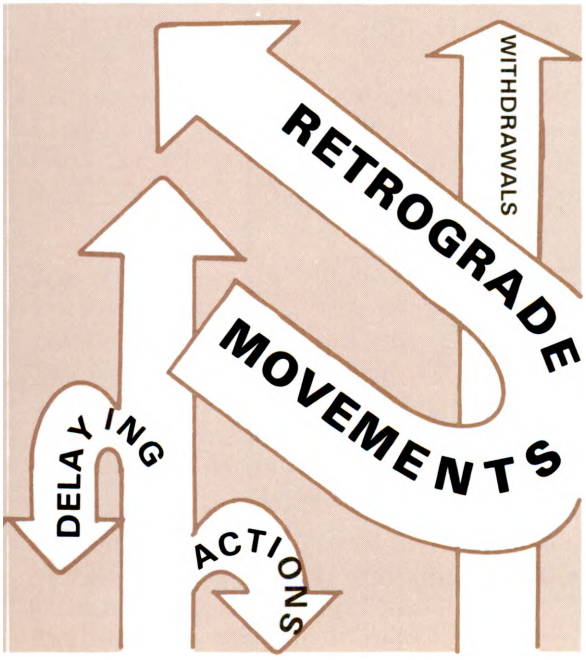
Once the defense plan is complete, the commander knows where he must be strong, where he can risk being weak, and how he can shift his forces during the battle. The defender places his strength to defeat the enemy's main effort. He must deceive the attacker on his strength and dispositions. The mission says to defend, and the subordinate commander determines how he will do this.

To be successful in the defense as in any other operation, we must have reliable communications. Depending on the time available, we will normally find a little more elaborate communications system in the defense. When we have to hold specific terrain, our primary communications will be with wire. If we are moving and bringing fire and offensive action to bear, we should place primary emphasis on secure FM radio and messengers. When the defense is hastily adopted, the communications facilities that are available will be used. As time and the situation permit, these facilities can be changed.

In the defense, our communications system interconnects all major command elements and provides entry into the communications system for covering forces, outposts, and reserves. Let's look specifically at the communications means. Signal centers are easily employed in the defense and provide the service discussed earlier in

the manual. They will not be required to displace as often as in the offense, but at times they will displace and personnel should be prepared to move on short notice. Messengers are effectively used in organizing and conducting defensive positions. They keep us off our radios and give us a high degree of signal security. Visual signals can be used by us in the defense as in other situations described in this book. Again, this type communications allows us to maintain radio silence and keeps the enemy wondering what we're doing. But let's remember that he can also see our signals and employ deceptive measures against us. In the defense, radio communications are not used as long as we have other communications means available. Radio nets can remain open, but on listening silence. Wire communications will be the primary means in the defense. High priority circuits should be established as quickly as possible to meet immediate requirements. Then more circuits can be installed as they're needed to meet requirements and increase communications traffic capacity and flexibility.

How Do We Communicate During the Retrograde Movement?



A retrograde movement provides for organized movement of our force to the rear or away from the enemy. It may be voluntary or caused by enemy action. Under either circumstance, it has to be approved by the corps or joint commander. The retrograde movement permits us to preserve our forces for use in another area or to realign or shorten defensive lines. Retrograde operations include *withdrawals* and *delaying actions*. The *retirement* is a third type of retrograde operation which takes place when we are not in contact with the enemy. But we will concentrate on the first two types.

The withdrawal is a deliberate attempt to break contact and free units for new missions. We should make every effort to keep the enemy from suspecting what we are doing because the withdrawal is very difficult under pressure. A delaying action causes the attacker to halt, deploy while exposed to fires, and then attempt to push the defender off his delay position. Generally, we become involved in retrograde operations which are a combination of the withdrawal and delaying action. So let's talk about communications for these actions.

During preparation for a retrograde movement, our existing communications should continue their normal operations. At CP locations which will soon be abandoned, new installation should be held to an absolute minimum while maximum use is made of existing facilities. As we move and establish successive CP locations, we should establish the minimum essential communications for command and control in anticipation of moving again.

We will see increased employment of special messengers to support the commander and his staff during the rapidly changing situation. Messengers will be kept at the old CP location to insure communications with forces left in contact with the enemy. We must closely supervise and regulate radio communications during disengagements. For deception purposes, dummy stations are used to maintain the normal traffic level at old positions when a CP is moving. Listening silence should be

enforced until a withdrawing unit reaches a designated position or has been committed in another location. Wire communications that are already in operation are used as much as possible in retrograde operations, while the installation of new wire lines is held to a minimum. We should consider constructing wire facilities to defensive or delay positions in the rear of the present positions. As the retrograde action progresses, wire lines that are not required should be recovered. If recovery is not possible, the wire lines should be destroyed by removing random sections. Where they're needed, march control points should be provided by tapping wire circuits that are toward the rear. As we lay our wire lines when we're moving to the rear, we must keep in mind that the more careful we are in selecting the routes, the more dependable the communications will be. Also, less maintenance time will be required if the routes are well selected. This means putting the wire where tracked vehicles cannot get to it. We must keep it away from roads, wherever possible. If we have to cross a road or trail, we bury the wire, put it overhead, or run it through culverts or under bridges.

What Are Relief Operations?

Forces in contact with the enemy may be relieved to conserve fighting power, to bring a reserve unit into action, or to relieve a unit for another mission. During relief operations, congestion and confusion are always dangers. To avoid trouble, we must have detailed planning to reduce vulnerability and risk. If your unit is involved in a relief operation, it should appear to be conducting normal activities. You should make maximum use of darkness and reduced visibility to avoid detection. Secrecy, deception, and speed of execution should be your goal. Let's consider these relief operations and examine their C-E aspects a little more closely.

● Passage of lines. -- Simply stated, a passage of lines occurs when a moving unit passes through a stationery unit already disposed on an established line. An example is when an incoming unit attacks through a unit in contact with the enemy. The incoming unit is the passing unit and the unit that remains in position is the passed unit. We can talk about a passage of lines in simple terms but it is one of the most difficult operations to accomplish on the battlefield. Imagine a division of 15,000 men with all the assigned equipment moving through a division of like size. This could be a disaster if every little nitty-gritty detail is not worked out by the commanders and their staffs. Coordination along with command and control are the key words. For a passage of lines to work correctly, the passed unit remains in position and supports the passing unit by all available means. After the incoming unit engages the enemy, the other unit can be withdrawn or committed to some other action. A passage of lines must be accomplished with the least amount of confusion and without enemy detection. To accomplish this, communications must be carefully and closely coordinated. Communications for the unit passing through the line will be restricted as much as possible to avoid interference and confusion between the two units.

Messengers should be used as much as possible for security reasons. They should be used within and between the two units involved.

Visual signals should be limited to prearranged identification signals, such as arm-and-hand signals, armbands, and panels. Care must be used with these because the enemy might also see them.

Radio is available. Radio silence and radio listening silence should be practiced to an absolute maximum to avoid enemy detection of our plans. In case we have to use the radio in an emergency, frequencies and call signs must be coordinated between the units involved to avoid confusion and interference.

Multichannel radio communications of the unit conducting the passage should not be employed until the passage of lines is complete, but the unit being passed through

should maintain normal traffic during the passage.

Wire communications of the unit being passed should not be affected. The unit making the passage should use the existing circuits as much as possible.

● Relief in Place. -- We will conduct this type of relief operation when the unit relieved is to be replaced by another unit. The relieving unit takes over all responsibility for the combat mission and area of operations of the relieved unit. Execution of a relief in place is accomplished while the unit being relieved is in the defense. It may be executed on a unit or area basis. During a relief in place, communications facilities of the unit relieved should remain in place until the relief is completed. Secrecy must be maintained. The enemy must not find out what we are doing. We are as vulnerable in this situation as we will ever be and the enemy knows this. So, if secrecy is not maintained and the enemy finds out our plans, he will hit us and cause maximum casualties because he has achieved surprise. Measures which help us maintain secrecy include --

● Radio silence. This is one of our most important precautions, so we should stay off our radios when we are relieving a unit.

● Only wire and messengers should be used for coordinating as the relieving unit moves up to the line and the relieved unit moves back. This again is to maintain secrecy by staying off our radios.

● The relieving unit should take over the call signs, radio frequencies, codes, and ciphers of the unit relieved so the enemy won't suspect that anything unusual is happening. The relief may take place at the time period for change of the day's CEOI material, thus minimizing the confusion of the changeover.

● The relieving unit should take over the existing C-E facilities to the extent possible so the electronic signature of the unit will not change.

As you can see, the C-E officer is a key to these relief operations. If he's on the ball and gets the cooperation of the commanders with whom he is working, the operations can be pulled off with secrecy and with minimal casualties.

What Must We Know About Special Operations?

We've discussed offensive, defensive, and retrograde operations, and we've touched upon relief operations. Let's go a step further and look at some operations which are less common to most of us. Yet, even though they are less common, their success could be the key to winning the next fight. These *Special Operations* require the same communications as those mentioned above but in different configurations. We must insure that our personnel are aware of the unique aspects of these operations and that they are adequately trained to communicate and to win the fight. In these next sections, we'll talk about the following special operations:

River Crossing

Airborne

Air Assault

Air Defense Artillery

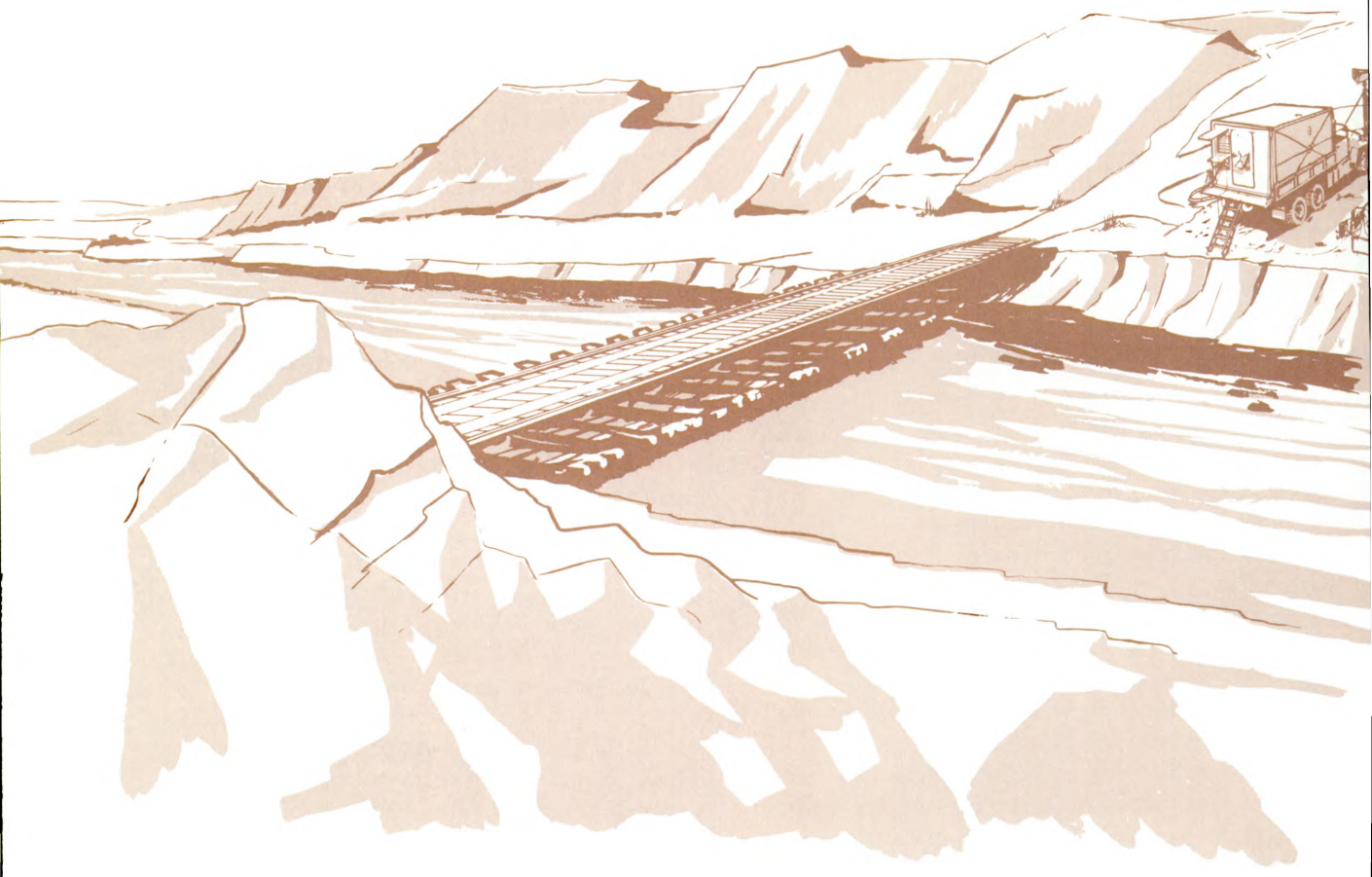
Riverine

Night

Internal Defense and Development

Military Operations in Built-up Areas

Amphibious



How Do We Communicate During River Crossing Operations?

We are now going strong in the attack and things are hot and heavy. There's one little problem. We have a river right in our path. We know that we must maintain our momentum and cross it as quickly as possible, destroy the enemy on the other side and secure our objectives. Getting our force across requires very close and continual coordination to prevent confusion and congestion at the river. This coordination and the success of the river crossing depends upon effective communications.

We have to insure continuous reliable communications between the crossing forces, traffic control personnel, the engineer and chemical units, and other elements involved in the crossing. We have to pull this off and still maintain surprise. We must keep the enemy from finding out about our crossing or at least keep him wondering exactly where we will be crossing.

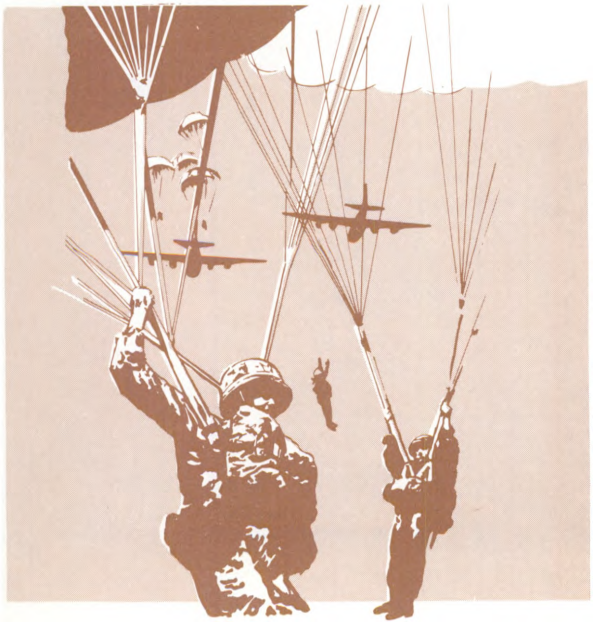
In order to gain surprise and maintain the security of our operational plans, we must use wire and cable up to the river, install wire and cable across the river to the bridgehead as soon as possible, and only use radio on an emergency basis. We'd better insure that the wire teams going across the river have been rehearsed and trained and have all the necessary gear. Wire communications are supplemented by our messengers during all phases of the river crossing operation. These include both special and scheduled foot, motor, and air messengers.

If we make contact on the enemy's bank and the element of surprise is lost, we can make quick use of our radios and visual and sound signals. To the extent possible, radio communications should be secure, and good communications practices, such as authentication, must be used. If these are ignored, the enemy will gain information from us and excessive casualties could be the result.

To satisfy our communications needs for a river crossing operation, circuits will exist between the forward area signal centers and division main. Wire circuits will be run from the area signal centers to provide communications between the division TOC and the crossing area commanders and key traffic control points at holding areas and crossing sites. If we have time, lateral lines should be established between the traffic control points and between the crossing area commanders (CAC). This gives us greater reliability through alternate routing. (See Appendix F.)

We will have some special communications requirements. These will be for units having primary responsibility for getting us across, the engineers and military police. They will require their own radio and wire nets. Communications will be required among the crossing area commanders, engineer and security units at the crossing sites, traffic control points (TCP), holding areas, and the division TOC. Also, we will need special traffic control radio nets to serve as an alternate means to the wire system and to control and coordinate units crossing during the assault. A couple of typical traffic control nets are shown in Appendix F.

How Do We Communicate During Airborne Operations?



Let's shift gears and get involved in airborne communications for a few minutes. Basically, the communications means for airborne operations are no different from other operations talked about in this manual. However, the employment concepts differ. Let's take a real broad brush of some of the highlights involved. We will talk about communications during the mounting phase, air movement phase, and the assault phase.

The mounting phase of an airborne operation starts when we receive the warning order and continues until we actually board the aircraft ferrying us to battle. It includes movement to the marshaling area and the marshaling process. Coordination is of prime importance to us during this phase since planning for an airborne operation is a joint undertaking. Our C-E plan must spell out responsibilities during each phase of the operation. It must also provide for coordinated use of communications facilities of all forces involved. This will always include at least two services -- Army and Air Force. We may also be required to communicate with forces in the objective area. These could include guerrilla, indigenous, or other friendly forces we'll be linking up with. We must insure that joint C-E plans provide for the communications support required.

During the marshaling process, we must rely upon C-E support from the commander of the marshaling area because the organic C-E equipment is being prepared for airlifting. The marshaling area is an assembly area near the aircraft, and is used for final preparation before boarding the planes. The packaging and rigging of equipment is of prime importance to us during this time. We want maximum equipment survivability. All equipment should be tested prior to packaging and, where possible, marginal items should be replaced. Communications required will depend upon the size, number, and dispersion of the marshaling areas. The C-E officer is responsible for coordinating the C-E requirements that will meet the commander's needs in the marshaling area.

If we have an airborne unit with an active communications system prior to an airborne operation, we must maintain normal traffic levels. We must not let our C-E system indicate that there will be an operation just because of a significant increase or decrease in traffic flow. We can prevent problems by using dummy stations and traffic. We must insure that personnel are furnished information necessary for continuing a realistic traffic pattern.

On our way to the airhead or objective area, necessary communications are provided by the carrier aircraft. Only the most urgent traffic will be authorized during the move. We can expect radio listening silence. Transmissions will be limited to those of an emergency nature and those having some bearing on the operation.

Let's jump into the assault phase of the operation. This phase starts upon departure from the aircraft and extends until the initial objectives are seized. When we hit the ground, every effort must be made to establish communications and regain command and control. Some communications which may be employed early in the assault phase include prearranged pyrotechnics, sound signals, and panels for unit assembly areas; assault radio net to link command elements to subordinate units; foot and motor messengers; and field wire, when distance and time permit.

We must keep in mind that sufficient C-E personnel and equipment should be delivered into the objective area during the assault for timely installation of CP communications. This will permit rapid development of a reliable communications system. Vehicle mounted radios, messenger vehicles, and field wire teams should be included in the first drops. We should try to arrange for air landing of large communications equipment. Therefore, delivery of this equipment should be deferred until air landing is possible. If the operations dictate it, however, equipment may be delivered by heavy drop, but we can expect a high damage rate.

C-E planning procedures for airborne operations have some peculiar details which we must consider. Communications facilities are provided by supporting units in the marshaling area. A detailed number of C-E personnel, equipment, and supplies are landed by parachute or aircraft. There must be adequate spares and followup items because they'll be needed for replacement of losses expected in the assault. Special sound and visual means, messenger communications, and assault radio nets must be used effectively to regain command and control early in the assault. Communications procedures and recognition signals are employed with allied forces in the airhead or in the air. Special arrangements are made for links to higher headquarters and logistic support bases. Finally, continuous communications between personnel on the ground (Army Assault Teams and Air Force Combat Control Teams) and the drop aircraft have to be maintained.

How Do We Communicate During Air Assault Operations?

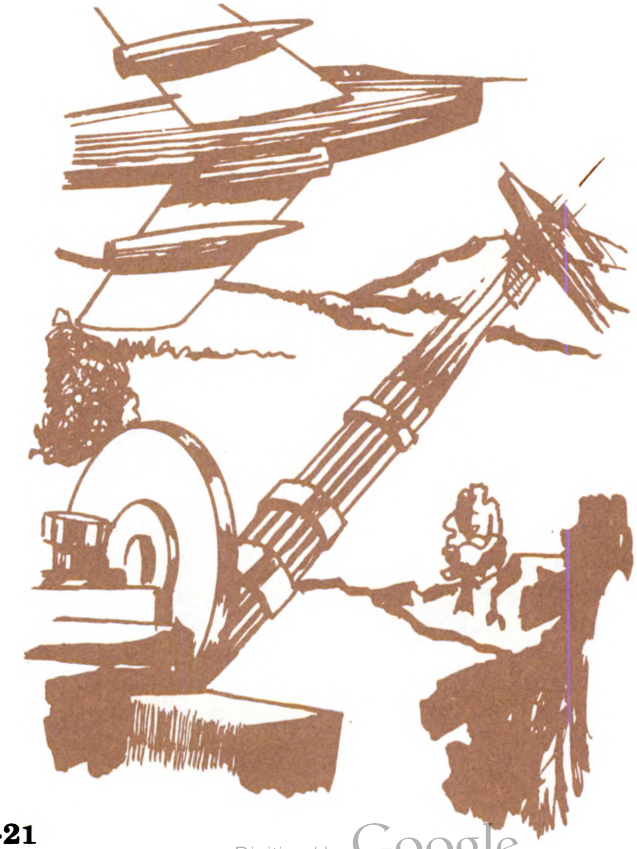
One of the fastest methods of moving around on today's battlefield is by air assault operations. Of course, if a fast-moving outfit is to survive, it must have responsive and flexible communications for command and control. Basically, communications in an air assault unit are air-to-air -- to provide command and control while on the way to the battle; air-to-ground -- to communicate with supporting Army aircraft; and ground-to-ground -- while operating on the ground. Let's look at some of the characteristics of these communications. Communications are required to widely dispersed units so emphasis is placed on compact, lightweight, air transportable, and air droppable equipment. Flexibility is necessary to meet changes in organization and to facilitate the relocation of units, command posts, and installations. Heavy reliance is placed on single channel radio as a primary communications means. Point-to-point multichannel communications are needed with emphasis on common-user circuits from the multichannel network. Another point is that there is a limited use of sole-user circuits.

During air assault operations, we will see unique command and control problems that require some variations from the C-E practices we are used to. For one thing, control is decentralized with maximum reliance on SOP and the initiative of subordinate leaders. Also, the communications system for an air assault operation consists primarily of radio networks connecting the base of operation with units in forward objective areas and with other supporting elements. Our command and control element for the base of operations may be either ground based or airborne. The system includes local telephone switching, limited multichannel communications between headquarters, and messengers. We will use wire and cable to interconnect key personnel in the CP. But, these means are not suitable for communications with subordinate units. The units are usually separated by long distances and the terrain between them may be under enemy control. So, radio represents the most practical means of communications.

In our air assault operations, because of the longer distances involved, aerial retransmission of single channel radio will often be necessary. This is especially true of FM voice radio communications. When we use these types of communications facilities, we must be sure to emphasize and practice maximum communications security.

Airborne command posts are particularly essential for command and control of air assault operations. This is normally accomplished with communications facilities aboard rotary wing aircraft. This command and control aircraft can be equipped with a communications console which provides FM, VHF, and UHF radios with COMSEC equipment. This enables the commander to locate the CP without worrying about ground movement restrictions because of the enemy or terrain.

How Do We Communicate During Air Defense Artillery Operations?



The airspace over the modern battlefield holds a tremendous threat to the Army in the next fight. The hostile jets and helicopters can hit us and put a stop to any operation. How does the Army prevent this -- air defense artillery. This, of course, is a very critical asset which has to be able to react fast. Communications links must be able to provide the rapid exchange of voice and the real-time exchange of data transmissions. We must also have parallel or backup communications to provide the necessary reliability for the critical air defense system.

Let's center in on the communications requirements for these ADA units. They will be widely dispersed and will make frequent and rapid moves around the battlefield. Our primary means of communications for an ADA unit with an electronic fire distribution system is a multichannel radio system. The minimum number of links that must be provided between the controlling elements and the fire units are one Automatic Data Link (ADL) and three voice channels. The ADL is very critical because it's used for the exchange of information that pertains directly to the battle. The information includes target identity, target position, firing commands, and firing results. The Air Defense Control (ADC) channel is a sole-user voice circuit. It is mainly used for passing status information, like the missile count, the alert status, and the unit readiness status. The Intelligence and Radar Reporting (IRR) channel is a sole-user voice circuit for two-way exchange of long-range target position data that cannot be transmitted over the ADL. The other channel, the Maintenance Channel, is a sole-user voice circuit. It is used for coordinating frequent operational and maintenance checks of elements of the air defense system without interfering with tactical operations. One final communications aspect which we must remember is the requirement for secure communications between units in order to pass traffic that's not associated with the fire distribution system.

How Do We Communicate During Riverine Operations?

A riverine operation presents an environment that is very unique and unfamiliar to most of us. If we should get into this environment, we would see an area where waterways are used as roads. We would see several major rivers or tributaries or an extensive network of minor waterways, canals, and irrigation ditches. We would see military units using air and water transportation because there are no road networks available. Suitable land for bases, airfields, and artillery firing positions may not be available.

With this type of environment in mind, let's look at the communications that would be needed. This operational environment places additional demands upon our communications resources and requires certain techniques not used in other areas. This is true because we have so many types of troop deployments; e.g., waterborne, overland, air assault, and airborne. Communications would certainly be different in riverine operations. No conventional signal centers would be available. Reliance on radio presents a greater threat, but it would be necessary. There would be a very limited use of wire and a greater joint communications requirement. Increased maintenance and weather-proofing of communications equipment would be needed. Finally, fewer CP echelons would be found.

In addition to land-based CP's, we would also see floating CP's aboard naval ships and barges. The communications equipment aboard these vessels normally would be provided by the Navy and would not be a part of the TOE of the Army element aboard the vessel. We have to insure that communications equipment for command and control is compatible with the land-based communications equipment. Additional Army equipment would be on board for use by personnel once they leave the ship. This includes portable radio sets, telephones, and field wire for shore use.

A more flexible communications system is required for the units because, even though they are operating in a conventional environment, they are constantly moving by unconventional means. Additionally, our units will probably have a larger area of responsibility for conducting operations.

During contact with the enemy in a riverine operation, we could see the commander over the battle in a command and control aircraft. This would enable him to have more reliable communications with ground elements. Also, airborne radio retransmission could be widely used. We can understand this because this environment doesn't lend itself to easy use of ground-based retransmission stations. This is due to limited land movement, the lack of roads, and also a lack of secure communications sites in the area of operations.

We must remember that, since we could be operating along with the Navy in this environment, we must be familiar with naval communications equipment, practices, and procedures. We may have to operate their equipment as well as communicate with them during an operation. We will probably encounter more maintenance problems than normal because of the damp environment, and waterproofing will be required for some equipment.

As we said earlier, the riverine force would depend primarily on radio communications for command and control, but it must limit the use of radios as much as possible. When they do talk, they must adhere to the sound communications security practices discussed earlier in this manual.

How Do We Communicate During Night Operations?

We are trained to move, shoot, and communicate around the clock. Our communications must be as effective during night operations as during daylight hours. Command and control is more difficult at night. To operate at night means tearing down, moving, selecting sites, erecting antennas, and laying wire when we can't see 3 feet in front of us. We learn to operate at night by training.

Reconnaissance of wire and cable routes is easier during daylight hours but we must also learn to do this at night to reduce casualties. If the enemy can't see us, he can't shoot us. We must maintain our wire communications at night for the same reason. Our people must be able to install telephone instruments and interconnecting cable between communications equipment.

In addition to training, there is another technique which can solve some of our problems -- the use of night vision devices. With these,reconnaissance of cable and wire routes is much easier and safer. Natural hazards and enemy ambushes can be avoided. We can reduce wire and cable circuit installation time and provide more responsive communications. Trouble-shooting and repair time, as well as installation of all equipment and accessories, is greatly reduced. Another plus for night vision devices comes from their use by operators of unit level switchboards under

blackout conditions. These devices eliminate the need for low-level lighting or reflectors that are normally used under these conditions. Night vision devices allow the operator to perform his normal duties while denying the enemy a target. They also enable the operator to defend himself if necessary. Although we will not need night vision devices for operation of C-E equipment in shelters, they will be needed for site selection and installation of wire and radio equipment. This is especially true in sighting and erecting directional antennas.

How Do We Communicate During Internal Defense and Development Operations?

Internal defense and development or IDAD operations are conducted by a host country or its allies against armed insurgents, their underground organization, or outside supporting power. IDAD measures which we may see employed include advisory assistance, tactical operations, intelligence operations, military civic action, populace and resource control operations, and psychological operations.

IDAD is special because it involves unconventional methods. Unit configurations will not necessarily conform to a TOE. Headquarters will probably not be divided into echelons. Headquarters elements and support units will most likely be consolidated with combat units to obtain added security.

In this IDAD environment, we will see commanders tailoring combat forces for specific tasks. This, in turn, will cause tailoring of C-E resources to meet the requirements of the tailored force. Due to the wide operational dispersion and limitations of FM radio and wire lines, the organic communications capability of tactical units may be significantly downgraded. When this happens, we may see multichannel radio and RATT teams attached or used in direct support. This will increase the communications organic to the maneuver units. When C-E requirements exceed capabilities, we must identify them and be prepared to get resources from other activities.

We hit basic planning steps and their importance back in chapter 3. IDAD operations present some unique planning problems. There are restrictions on ground movement because of the danger of guerrilla activities. So, air movement will be used as much as possible. Communications planning will often involve units besides the US unit. In IDAD operations, we will be required to communicate with armed forces of a host country, with paramilitary units, and with civilian agencies. Under these conditions, frequency coordination is very important if we want to maintain effective communications.

Wide dispersion of units and restriction on ground movement can impact on the ability to maintain a high state of reliability in C-E equipment. Keep in mind that our tried

and trusted supply and maintenance procedures may require extensive revision. Our application of sound defense techniques should receive a number one priority so we can count on surviving. Communications sites are prime targets for guerrilla, terrorist, and sabotage tactics, as well as coordinated attacks by an insurgent force.

We must build flexibility into our communications in an IDAD environment. This may mean we'll have to resort to field expedients and use alternate communications means. Flexibility can also be improved if we try for maximum decentralization of C-E resources. This will enable the necessary C-E element to react without bogging down the whole outfit. We should make sure that more than one mission is assigned in advance. This will enable C-E elements to respond quickly to a variety of situations. Also, we must have effective communications to all C-E elements for control purposes.

In an IDAD environment, communications security is of prime importance. Sometimes we won't be able to tell the enemy from the ally. We'll never know when and where the enemy is listening to us. We must continue to employ those measures which deny the enemy the opportunity to locate us and hit our positions.

Another important item that is often overlooked is logistical support for our communications elements. In an IDAD environment, maintenance and resupply of C-E elements may present a problem because of unsecured road networks. Aerial supply and decentralized maintenance should be considered. Maintenance can be done by attaching personnel to the sites or by using air transported contact teams. When we depend on air transportation for logistical support, we should try to maintain adequate supplies, backup equipment, and repair parts at the communications sites in case air transportation is eliminated for a few days because of weather or enemy action.

How Do We Communicate During Military Operations in Built-Up Areas?

During World War II, when the US and its allies hit the first cities in Europe, they were relatively untrained in city fighting. But, as they rolled across Europe, they

gained a wealth of experience. It became apparent that this type fighting was a platoon or squad size operation. Tanks were very vulnerable to light antitank weapons employed from concealed positions within the city. Houses that were converted into strongpoints were cleared by infantry moving from room to room and from floor to floor. Tunneling, mining, and booby-trapping were used very effectively.

Today we find only a few people on active duty who participated in this city fighting. Bypassing urban areas would be the best doctrine, if we could always do that. This would be especially true, if the city has no value as a tactical objective. However, cities often are in the path of our lines of communications, and may have to be taken or defended by us. The rapid growth of urban areas mean that, in the next battle, we are likely to get involved in combat in built-up areas. So, we must prepare ourselves and train for this possibility. In the next battle, instead of setting up our CP under those nice tall trees for cover and concealment, we might have to move into a town or village and use buildings and existing facilities for our communications facilities.

The use of communications in built-up areas in both World War II and the Korean War was restricted by the state of the telecommunications art. Although today our communications equipment is more reliable and powerful, we still face some of the same restrictions. The buildings in a city will reduce the range of our FM single channel radios, and the use of wire is difficult because of the congestion in a built-up area. This is a significant problem for the small units and their commanders who must do the job of clearing the city. We can make effective use of our communications equipment, however, if we recognize its limitations and then make maximum use of its capabilities. No special communications gear will be issued to support fighting in the city. The way we use the organic equipment and the indigenous systems will make the difference.

Frequency modulated (FM), very high frequency (VHF) radios, which are normally the guts of command and control, will have their effectiveness reduced in built-up areas. The operating frequencies and power output of the sets demand a line-of-sight between antennas. Line-of-sight at street level is not always possible in built-up areas. Amplitude modulated (AM) high frequency (HF) sets are less affected by the line-of-sight problem because operating frequencies are lower and power output is greater. HF radios are not organic to the small units that will conduct the clearing operations. *How can we overcome this problem?* Retransmit the FM, VHF systems. Retransmission stations in aerial platforms could provide the most effective means if they are available. Most likely, organic retransmission sets will have to be used. The antennas should be hidden or blend in with the surroundings so they won't be landmarks for the enemy to home in on. They can be concealed by such things as water towers, existing civilian antennas, and steeples.

We can reel out our wire while we are in static positions, but we have to be careful when we plan our wire routes in this mess. Existing telephone poles can be used to raise our wire lines above the streets. Ditch lines, culverts, and tunnels can be used to keep the wire below the streets. If these precautions are not taken, we will have tracked and wheeled vehicles constantly tearing our lines apart and disrupting communications.

Messengers provide security and flexibility, however, we must carefully select messenger routes to avoid any pockets of enemy resistance. Visual signals, such as arm-and-hand signals, take on added importance because of the limitations of our radios. They are excellent for calling for fire, lifting or shifting fire, and for indicating the seizure of buildings. Pyrotechnics, smoke, and marking panels are also excellent means for communicating in the city, but they must be well coordinated and fully understood.

The noise of combat in built-up areas makes it difficult for us to effectively use sound signals.

The prompt seizure of existing C-E facilities must be included in the assault planning and we should make every effort to prevent damage or destruction of these facilities. The local telephone system is already in place and tailored to the city or town. Its capture by our forces gives us wire communications with overhead and buried cable. This helps us overcome the problems with our radios and gives us a cable system less susceptible to combat damage. Local media, such as newspapers, radio stations, and TV stations, can provide us with communications with the local populace after the level of combat starts to decline. Intact police or taxi facilities are also a possibility for a radio system tailored to the city with retransmission facilities already in place.

Let's consider a few more steps that should be taken while we're inside a city. These steps can make a big difference in winning the fight. We should park vehicles inside buildings for cover and concealment, and dismount equipment and install it inside buildings (in basements, if they're available). We should place generators against buildings or under sheds to increase noise absorption and provide concealment. When we run wire, we should try to run it through buildings which are still intact, if they provide a good route. We should place antennas on roof slopes away from the enemy, and knock holes in walls below rooftop level for directional antennas.

How Do We Communicate During Amphibious Operations?

As we mentioned in chapters 2 and 3, we have to plan and train to operate and communicate with the other services. An amphibious operation is a prime example of the services operating closely together and maintaining communications with each other. Amphibious warfare integrates all types of ships, aircraft, weapons, and landing forces. Each service has to completely understand its role and how it ties together with the other services involved. We have to have secure, flexible, and reliable communications to provide command and control and tie the whole thing together.

Let's look at the five steps in an amphibious operation. *Planning* begins when the orders for the operation are received and continues throughout the operation. The *embarkation* involves loading the troops, equipment, and supplies into naval vessels. A *rehearsal* should be staged so that all task force elements can test the C-E systems and equipment. However, we must be aware of the enemy signal intelligence threat. One precaution that can be taken is low power on radios and test equipment. Another precaution is using frequencies other than the actual frequencies to be used in the operation. During the *movement* to the objective area, naval forces will provide all external and intership communications. In

the *assault,* lightweight, essential C-E equipment is moved to the beachhead first. As the battle develops, troops move inland and communications requirements will increase. We will be moving heavier, more complex, and higher capacity C-E equipment to expand the communications system. During the assault, we will rely primarily on single channel radio and multichannel communications. After a beachhead is established, wire and messengers can be integrated into our communications system. The communications plan for the landing force must provide for rapid development of communications ashore so we can insure a responsive C-E system as the assault progresses.

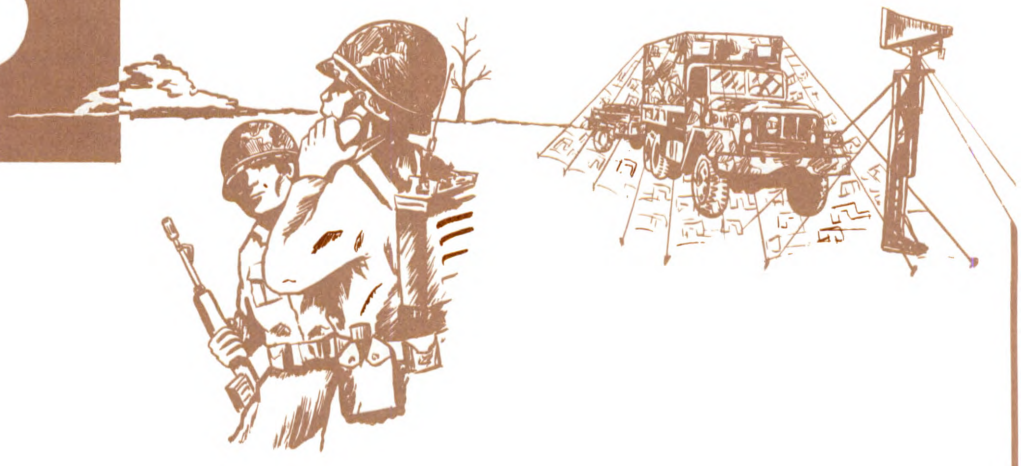
During an amphibious assault, we will depend heavily upon fire support from the Navy and Air Force. This calls for a reliable communications system with these services to support the troops on the ground. During the period between the initial landing of Army ground troops and the landing of supporting artillery, fires are provided by naval vessels and tactical aircraft. Instantaneous, reliable communications are imperative. A *Shore Fire Control Spotting Net* and a *Tactical Air Request Net* will meet the requirements.

The *Shore Fire Control Spotting Net* ties the ground elements ashore with the fire support ship. Fire support requests are passed from shore fire control parties to the ship. Sometimes an air spotter is also involved and will be tied into the naval gunfire spotter and the fire support ship. The *Tactical Air Request Net* is monitored by the tactical air control center of the amphibious task force and by the air liaison officer of the landing force. It is used to request immediate air support missions, to furnish tactical information, and to report effectiveness of the air strikes.

Direct support field artillery is normally landed only when it's needed. If it is called in, centralized fire control within each artillery battalion is established as soon as possible. Radio is used between artillery forward observers, naval gunfire teams, naval gunfire liaison officers, and fire support ships.

In the absence of normal combat service support provided by higher echelons, each echelon of a landing force forms a temporary combat and logistical support organization known as a *shore party.* Shore party communications are provided by C-E elements of the Engineer Amphibious Group and are an integral part of the landing force network. Shore party communications provide for landing force participation in control of the ship-to-shore movement. They provide operation, control, and direction of administrative support of the landing force and temporary telephone communications between the beaches and tactical organizations inland. Shore party radio communications include a local net, a shore party command net, lateral links, and liaison nets. The local net links the shore party commander, beach master, shore party message center, and other shore party installations. The shore party command net links shore party commanders with tac-log groups and principal headquarters of the landing force. Lateral links join each shore party with adjacent shore parties. Finally, the liaison nets provide communications between the shore party and the tactical headquarters ashore to speed the response of the administrative support system.

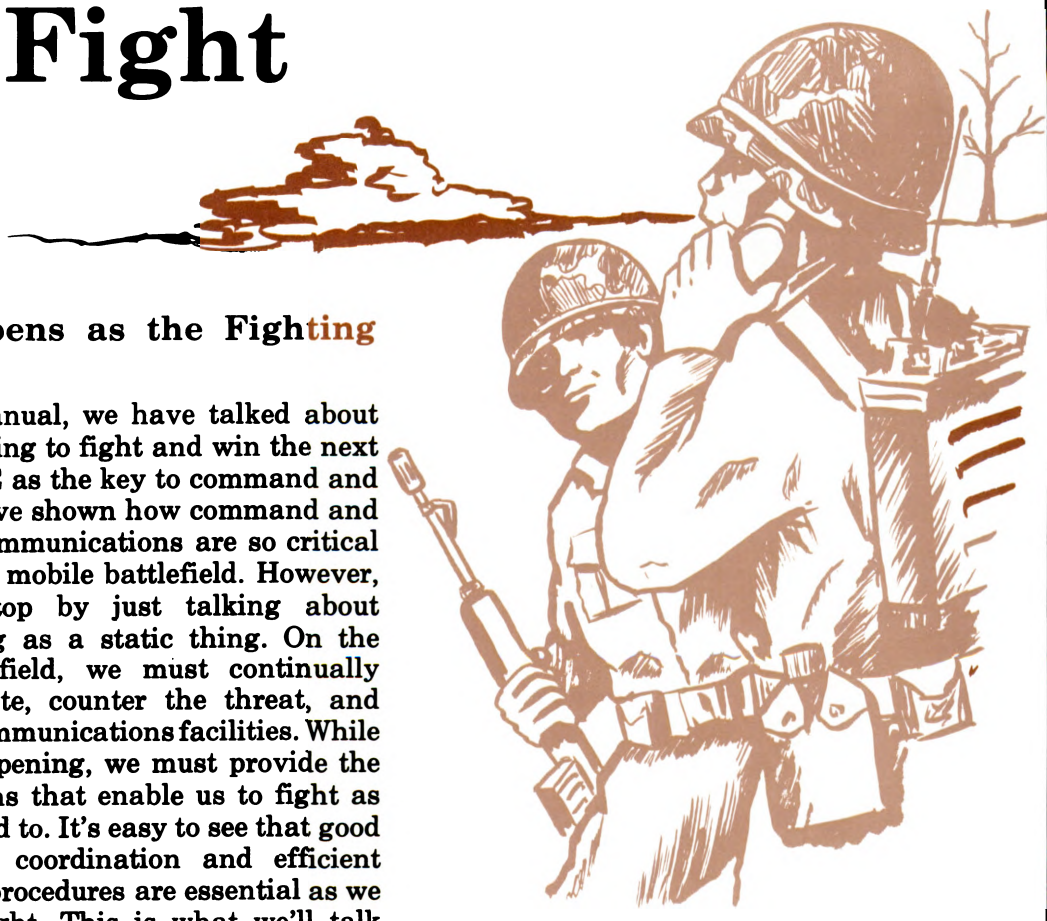
CHAPTER 6



Chapter 6. Continuing the Fight

What happens as the fighting continues?
What's involved in continued C-E planning and coordination?
How will displacements affect communications?

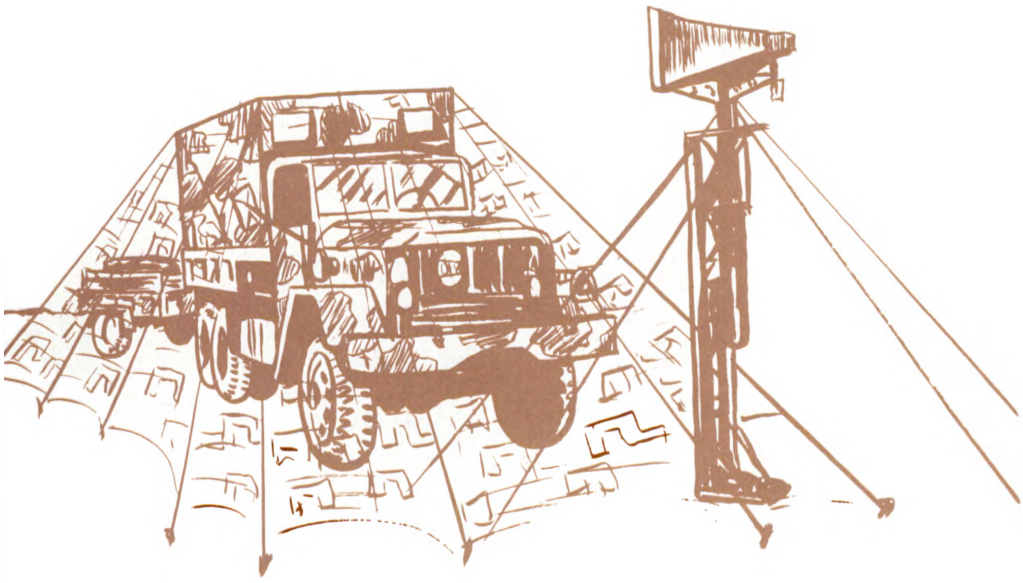
Continuing the Fight



What Happens as the Fighting Continues?

In this manual, we have talked about how we are going to fight and win the next battle with C-E as the key to command and control. We have shown how command and control and communications are so critical on a fluid and mobile battlefield. However, we cannot stop by just talking about communicating as a static thing. On the modern battlefield, we must continually plan, coordinate, counter the threat, and relocate our communications facilities. While all this is happening, we must provide the communications that enable us to fight as long as we need to. It's easy to see that good planning and coordination and efficient displacement procedures are essential as we continue to fight. This is what we'll talk about in this chapter.

We'll hit planning one more time. We discussed most aspects of planning for the fight in chapter 3, so we won't belabor the point. But remember that this planning is an ongoing thing and never stops. The proverbial five P's--"Prior planning prevents poor performance"--applies even more today in the environment that we discussed in chapter 1. So far in this book, we have marched step by step from discussing the tactical objectives and environment, to training and planning for the fight, through moving to the fight, and then joining the fight. We are now to the point where we could logically stop. However, to stay ahead of the enemy, we *must not* stop or even slow down in our planning for the next stage of the fight. It's just like in football where the coach must be looking ahead to the next game, planning his strategy, developing new plans to counter his opponent. He knows his opponent is doing the same thing and that his plan must be better if he is to continue to win even when the odds are against him. We cannot end our treatment after we arrive on the battlefield. To survive and continue to communicate, we must "recycle" back to chapter 3 and continue our planning--an ever-evolving process.



What's Involved in Continued C-E Planning and Coordination?

In order to plan for the changing C-E requirements on the battlefield, we must maintain continual two-way coordination during all phases of the battle. Let's discuss some of the questions that must be answered to keep the planning on track. *Who needs communications?*--We must know this to establish priorities and marry up equipment and personnel with requirements. *What communications are required?*--We have to know the mix of communications required, such as FM single channel, RATT, multichannel, and telecommunications center service. *Where are the communications required?*--When this is known, we can begin "on-the-ground" planning and actually engineer the communications system which will be needed. *When will communications be required?*--This information is needed so we can insure that customers have uninterrupted communications available. *How long will the communications be required?*--The length of the requirement allows us to plan logistical support to insure continuous quality communications.

The combat commander and his staff and the C-E officer, in particular, must continually consider these basic questions. The answers will be applied to existing communications requirements as well as future requirements. Once existing communications are no longer needed, the means will be applied to other requirements as they develop on the battlefield.

We must not get tunnel vision and only look at communications requirements. We must continue to take care of logistics, physical security, signal security, the EW threat, and the signal intelligence threat. It's this comprehensive effort that enables us to support the communications operations, protect our resources, and counter the threat in the electromagnetic environment.

How Will Displacements Affect Communications?

On the modern battlefield, we cannot expect to stay in one place for very long. Units will be moving back and forth, command posts (CP's) will be displacing, communications facilities will be moving all over the battlefield. So we can see that our units will be constantly planning, installing, and moving communications facilities.

How often can we expect these CP's to move? Just look at these future CP displacement "objectives" under consideration by the Army:

Echelon	Set Up	Tear Down	Frequency
Division	30 min	30 min	1-3 times/day
Brigade	15 min	15 min	3-5 times/day
Battalion	5 min	5 min	3-4 hours

(You are "set up" when you can send your first message and make your first "telephone call" outside your CP.)

Just these figures by themselves probably don't mean a whole lot, and again they are "objectives." But, let's look at how they will impact upon our communications. They mean that in the future the communications facilities must be able to set up, tear down, and reestablish communications much faster and more often than we've been used to on the battlefield in the past. It means that supervisors and operators must be aware of the impact of these mobility objectives and must always be at a high state of training. They must be able to get those communications established in record time.

You may have heard the story of the C-E officer who stuck his head out of the tent at daybreak to check the weather. The weather looked good but something was wrong. Suddenly it dawned on him that his unit had pulled up stakes and moved out. This young man was in trouble. It appears that this C-E officer and the combat commander have not been talking to each other. If they had, the C-E officer and his communications would have displaced along with the command post. Let's quickly look at two types of displacement, then discuss a few sound practices to keep in mind out there on the battlefield.

● Phased Displacement.--One method of displacement is first installing minimum essential communications at the new location. This provides continuity in communications for the first elements of the CP which is displacing. It also enables command and control to be transferred smoothly from the old to the new CP location. The communications are phased out at the old location and built up in the new area. This is done as rapidly as the movement of elements of the headquarters will permit. This process continues until the old location is closed out. The C-E officer will always notify C-E elements of any expected displacements. This should be done as early as possible for planning purposes. Timely coordination will allow multichannel radio systems to be planned and cable route surveys to be made. Reconnaissance of areas for multichannel terminals, radio parks, and other communications equipment locations should be made before the displacement takes place.

● Total Displacement.--In the second type of displacement, operations close out at the sustaining CP at a designated time and all personnel and equipment move together to a new location. An alternate CP is in control until the sustaining CP is back in action and has sufficient communications to resume command and control.

● Sound Communications Management Practices.--When you are involved in CP displacement, the most important thing to remember is that we must be able to displace without interrupting service to subscribers in the system. We must ask ourselves, *"How do I move and continue to maintain command and control and communications?"* This, of course, is done by employing sound communications management practices. Let's look at a few that should be kept in mind.

☐ Continual coordination with units in old CP area--Command element must keep C-E element informed of projected displacements. C-E element must keep command element informed on the C-E implications of projected displacements.

☐ Reconnaissance--C-E officer should recon new CP location with the commander and advise him on suitable communications locations.

☐ Frequency coordination--We must insure that there is no friendly frequency interference in new CP area.

☐ Coordination with subscribers--We must tell subscribers what communications service is available and when it will be available.

☐ Communications with advanced party--We must establish minimum communications rapidly to provide command and control at new CP location.

☐ Coordinate logistical support--We must insure logistical support is available.

☐ Physical security--We must coordinate with appropriate units if physical security support is needed.

☐ Maintain communications traffic level--We must generate dummy communications traffic if it's necessary to maintain established levels. We do this so the enemy will not suspect a movement, based on a change in communications patterns.

☐ Electronic countermeasures (ECM)--We must continue to counter this threat by ECCM and signal security practices.

-- Wrap-Up --

In this "How to Fight" manual, we've laid out basic guidelines for us to win the battle in the Electromagnetic Environment on the Battlefield. FM 11-50, *Combat Communications Within the Division,* and FM 11-92, *Combat Communications Within the Corps,* are "How to Fight" manuals that present much more specific information on how Communications-Electronics must be employed in the next fight.

The appendixes that follow this chapter have been compiled to give a ready reference on a variety of C-E subjects. By compiling the information in one place, we've provided a number of tools to aid the communicator and those involved in communications.

Appendix A—Key Publications

Allied Communications Publications (ACP)

(C) 100	US Call Sign and Address Group System-Instructions and Assignments (US Supplement No 1) (U).
(C) 110	Tactical Call Sign Book (U).
117	Allied Routing Indicator Book (U).
117 (US Suppl 1)	Allied Routing Indicator Book (U).
117 (US Suppl 2)	Joint Data Routing Indicator Book (U).
117 (US Suppl 3)	DCS Teletypewriter Network Routing Doctrine (U).
(C) 117 (US Suppl 4)	US Special Purpose Routing Indicator Book (U).
117 (US Suppl 5)	United States Military TWX/TELEX Director (U).
117 (CAN-US Suppl 1)	Allied Routing Indicator Book-Canada-United States (Supplement No 1) (U).
(C) 121 (US Suppl 1)	Communications Instructions-General (U).
(C) 121 (NATO Suppl 1)	Communications Instructions-General NATO Basegram System (U).
124	Communications Instructions-Radiotelephone Procedures. (U).
125 (US Suppl 2)	Radiotelephone Procedures for the Conduct of Artillery and Naval Gunfire (US Suppl No 2) (U).
(R) 126	Communications Instructions-Teletypewriter (Teleprinter) Procedure (U).
(R) 127	Communications Instructions-Tape Relay Procedures (U).
127 (US Suppl 1)	Communications Instructions-Tape Relay Procedures (US Supplement No 1).
129	Communications Instructions-Visual Signaling Procedure (U).
131	Communications Instructions-Operating Signals (U).
134	Telephone Switchboard Operating Procedure (U).
136	Communications Instructions-Panel Signaling (U).
167	Glossary of Communications-Electronics Terms (U).
168	Pyrotechnic Signals (U).
(C) 190 (US Suppl 1)	Basic Armed Forces Frequency Plan, US Supplement No 1 (U).

Standardization Agreements (STANAG)

2014	Operation Orders, Annexes to Operation Orders, and Administrative/Logistics Orders.
2019	Military Symbols.
2028	System for Field Wire Labeling.
2043	Principles and Procedures for Establishing Communications.
2047	Emergency Alarms of Hazards of Attack.
2109	Telecommunications Symbols.

Joint Army-Navy-Air Force Publications (JANAP)

(C) 119	Joint Voice Call Sign Book (U).
128	AUTODIN Operating Procedures (U).
(S) 141	US Joint Military Radio Frequency Allocation Plan (U).
(C) 194	Basic Armed Forces Communication Plan (BAFCOM) US Army Communications Frequency Plan (U).
(C) 201	Status of Noncryptographic JANAP's and ACP's (U).

Army Regulations (AR)

66-5	Armed Forces Courier Service: Administration and Operations.
66-6	Armed Forces Courier Service: Charter.
105-10	Communications-Electronics: Communications Economy and Discipline.
105-31	Communications-Electronics: Message Preparation.
105-32	Communications-Electronics: Authorized Addresses for Electrically Transmitted Messages.
105-40	Communications-Electronics: Teletypewriter and Telephone Conferences.
105-86	Communications-Electronics: Performing Electronic Countermeasures in the United States and Canada.
(C) 105-87	Communications-Electronics: Electronic Warfare (U).
340-15	Reports and Statistics-Preparing Correspondence.
340-18-11	Reports and Statistics-Maintenance and Disposition of Communications.
380-5	Security-Department of the Army Supplement to DOD 5200.1-R.

380-20	Security-Restricted Areas.
(C) 380-40	Security-Department of the Army Policy for Safeguarding COMSEC Information (U).
380-41	Security-Department of the Army Policy for Control of COMSEC Material.
(C) 380-52	Nonmachine Crypto Systems and Authentication Systems (U).
380-105	Security-Policy and Procedure Governing Use of Code Words, Nicknames, Short Titles, and Similar Devices.
(C) 381-14	Military Intelligence-Counterintelligence-Technical Surveillance Countermeasures (U).
(C) 530-1	Operations Security (U).
(C) 530-2	Communications Security (U).
(C) 530-3	Electronic Security (U).
(C) 530-4	Control of Compromising Emanations (U).
604-5	Personnel Security Clearance-Clearance of Personnel for Access to Classified Defense Information and Material.
640-15	Personnel Records and Identification of Individuals–Criteria for Insuring the Competency of Personnel to Install, Maintain, and Repair Communications Security Equipment.

"How To Fight" Manuals

	CAPSTONE
100-5	Operations.
101-5	Operations Control and Coordination.
71-100	Division Operations (Mech/Armor).
71-101	Division Operations (Inf/Abn/Ambl).
	COMBAT
71-1	The Tank/Mechanized Infantry Company Team.
71-2	The Tank/Mech Battalion Task Force.
71-3	The Brigade (Mech/Armor Div).
7-7	Rifle Platoon.
7-10	Rifle Company.
7-20	Infantry Battalion (Abn/Ambl).

COMBAT (cont.)	
7-30	Infantry Brigade (Abn/Ambl).
7-85	Ranger Operations.
17-12	Tank Gunnery.
17-50	Attack Helicopter Operations.
17-45	Air Cavalry Combat Brigade.
17-95	Cavalry.
100-999	Air/Land Operations.

COMBAT SUPPORT	
5-135	Engineer Unit Operations (Mech/Arm).
5-136	Engineer Unit Operations (Inf/Abn/Ambl).
5-142	Engineer Unit Operations (Non-Div).
6-20	Fire Support for Combined Arms Operations.
11-50	Combat Communications Within The Division.
11-92	Combat Communications Within the Corps.
21-40	NBC Defense.
23-17	Redeye.
24-1	Combat Communications
44-1	Air Defense Artillery Employment.
44-3	Chap/Vulcan Employment.
44-90	Hawk Employment.

SPECIAL OPERATIONS	
90-1	Employment of Army Aviation-High Threat Environment.
90-2	Deception Operations.
90-3	Desert Operations.
90-4	Air Assault Operations.
90-5	Jungle Operations.
90-6	Mountain Operations.
90-7	Denial Operations and Barriers.
90-8	Counterguerrilla Operations.
90-9	Night Operations.
90-10	Military Operations in Built-Up Areas.
90-11	Northern Operations.

90-12	Airborne Operations.
90-13	River Crossing Operations.

Field Manuals (FM) with C-E Information

6-10	Field Artillery Communications.
11-23	Theater Army Communications Command.
11-40	Tactical Audio Visual Doctrine.
21-30	Military Symbols.
21-60	Visual Signals.
23-30	Grenades and Pyrotechnic Signals.
24-2	Radio Frequency Management.
24-16	Signal Orders, Records, and Reports.
24-17	Tactical Communications Center Operation.
24-18	Field Radio Techniques.
24-20	Field Wire and Field Cable Techniques.
24-21	Tactical Multichannel Radio Communications Techniques.
(C) 32-5	Signal Security (SIGSEC) (U).
(S) 32-10	USASA in Support of Tactical Operations (U).
(C) 32-20	Electronic Warfare (U).
32-30	Electronic Warfare-Tactics of Defense.

Appendix B — Key Words and Phrases

In this section, you are provided with an explanation of key words and phrases used in the C-E field. Although some terms may have been explained within the text, this list will give you a compact, ready reference as a point of departure on each subject.

-A-

acknowledgement - A message from the addressee informing the originator that his communication has been received and is understood.

addressee - The activity or individual to whom a message is directed by the originator. Addressees are indicated as either ACTION or INFORMATION.

address indicating group (AIG) - An address group which represents a specific set of action or information addressees.

AIM Division - Armored, Infantry and Infantry (Mechanized) Division.

airhead - A designated area in a hostile or threatened territory which, when seized and held, insures the continuous air landing of troops and materiel, and provides maneuver space necessary for projected operations.

antenna polarization - The orientation of the antenna elements in either a vertical or horizontal position.

area signal center - This signal center provides communications to units within its assigned geographical area of responsibility. This ties the units into the area communications system and supplements their organic means for communications with higher, subordinate, or adjacent headquarters.

attenuation - Decrease in strength of a signal, beam, or wave as a result of absorption of energy and of scattering out of the path of a receiver.

audio frequency - A frequency which can be detected as a sound by the human ear. The range of audio frequencies extends from approximately 20 to 20,000 hertz.

authentication - A security measure designed to protect a communications system against fradulent transmissions.

automatic central office - A switch at which communications between subscribers is effected without the intervention of an operator. The electronic switches are controlled by the operation of a keysender on the originating subscriber's instrument.

automatic data processing system (ADPS) - Automatic data processing equipment linked together by communication and data transmission equipment to form an integrated system for the processing and conveyance of data.

-B-

bandwidth - *Necessary.* For a given class of emission, the minimum value of the occupied bandwidth sufficient to insure the transmission of information, at the rate and with the quality required, for the system employed under specified condition. Emissions necessary for the proper functioning of the receiving equipment, such as the emission of a carrier in a reduced carrier system, will be included in the necessary bandwidth. *Occupied.* The bandwidth occupied by an emission is the band of frequencies comprising 99 percent of the total radiated power, extended to include any discrete frequency on which the power is at least 0.25 percent of the total radiated power.

brevity code - A code which provides no security but which has as its sole purpose the shortening of messages rather than the concealment of their contents.

-C-

call sign - Any combination of characters/numbers or pronounceable words, which identifies a communication facility, command, authority, activity, or unit; used primarily for establishing and maintaining communications.

carrier wave - A wave, usually sinusoidal, which is modulated to transmit signals. The frequency of the wave is called the *carrier frequency*. The carrier wave is not transmitted in some types of modulation.

central office - A room, building or vehicle equipped so that telephone lines terminating there may be interconnected as required. The equipment may include a manual or automatic switch.

chaff - Radar confusion reflectors, which consist of thin, narrow metallic strips of various lengths and frequency responses, used to reflect echoes for confusion purposes.

chain of command - The succession of commanding officers from a superior to a subordinate through which command is exercised.

channel - A facility for telecommunications on a system or circuit. The number of independent channels on a system or circuit (derived by frequency or time division) is measured by the number of separate communication facilities that can be provided by it.

cipher, off-line - A method of encryption which is not associated with a particular transmission system and in which the resulting cryptogram can be transmitted by any means.

cipher, on-line - An automatic method of encryption associated with a particular transmission system, whereby signals are encrypted and passed directly through the line to operate the reciprocal equipment at the distant station.

cipher system - Any cryptosystem which, by means of a key, converts plain or encoded text or signals into unintelligible form, and vice versa.

circuit - *Communications term.* An electronic path between two or more points capable of providing a number of channels. *Engineering term.* A number of conductors connected together for the purpose of carrying an electrical current.

code - Any system of communications in which arbitrary groups of symbols represent units of plain text of varying length. Codes are provided primarily for one of three purposes: (1) In the broadest sense, coding is a means of converting information into a form suitable for communication and encryption; (2) Brevity codes are used to reduce the length of time necessary to transmit information; (3) Security codes are used to provide some degree of cryptographic protection for the information being transmitted.

code word - (1) A word which conveys a meaning other than its conventional one, prearranged by the correspondents. Its aim is to increase security. (2) A cryptonym used to identify sensitive intelligence data.

collective training - The preparation of soldiers to perform those team or unit tasks essential to the accomplishment of a unit's TOE or operational mission.

command and control - An arrangement of personnel, facilities, and the means for information acquisition, processing, and dissemination employed by a commander in planning, directing and controlling operations.

command post - A unit's headquarters from which command and control is centrally exercised.

command signal center - This signal center provides communications for command and control at division and corps headquarters and to units located in the immediate area as facilities permit.

command system - A communications network which connects an echelon of command with some or all of its subordinate echelons for the purpose of command and control.

common-user circuit - A circuit allocated to furnish communications paths between switching centers to provide communications service on a common basis to all connected stations or subscribers.

communications-electronics (C-E) - Embraces the design, development, installation, operation, and maintenance of electronics and electromechanical systems associated with the collecting, transmitting, storing, processing, recording, and displaying of data and information associated with all forms of military communications.

Communications-Electronics Operation Instructions (CEOI) - A series of orders issued for the technical control and coordination of the signal communication activities of a command.

Communications-Electronics Standing Instruction (CESI) - A series of instructions explaining the use of items included in the CEOI. The CESI may also include other technical instructions required to coordinate and control the communications-electronics operations of the command.

Communications Equipment Support Element (CESE) - Individual elements of the C-E system--radio, switch, multiplex, wire teams, maintenance, etc.

Communications Nodal Control Element (CNCE) - A dual function facility that incorporates both Facilities Control and Technical Control requirements. The technical control element of the CNCE contains patching, testing, conditioning, and monitoring equipment and provides technical control of circuits in and through the facility. The management element of the CNCE provides management and control of C-E functions within the node.

Communications System Control Element (CSCE) - Provides actual focal point for dynamic control, acts as operations center for command system, and directs organic and subordinate C-E systems. Maintains the data base. Replaces the term SYSCON.

Communications Security (COMSEC) - Measures taken by you to prevent unauthorized persons from gaining information of value from your communications. It includes cryptosecurity, physical security, transmission, and emission security.

Communications System Planning Element (CSPE) - Consists of the staff and operational planners at each element and provides all the long-range planning.

continuous wave (CW) - Morse code transmissions achieved by on and off keying of an unmodulated carrier wave, or by the keying of a modulating subcarrier wave with the carrier suppressed.

crossing area commander - The officer responsible for controlling the flow of troops, equipment, and supplies to be moved across the river by surface means.

cryptography - The art or science which treats the various means and methods for rendering plain text unintelligible, and reconverting cipher text into intelligible form.

cryptomaterial - All material, including documents, devices, equipments, and apparatus essential to the encryption, decryption, or authentication of telecommunications. When classified, it is designated CRYPTO and subject to special safeguards.

-D-

data link - A communication link suitable for transmission of data.

date/time group (DTG) - Depending upon national requirements, the DTG may indicate either the date and time when the message was officially released by the releasing officer, or the date and time when the message was handed into a communication facility for transmission. The DTG is expressed as six digits. The first two indicate the day of the month and the last four indicate the time of day. The six digits are followed by the zone suffix and the month expressed by the first three letters (e.g., 010900Z SEP represents 0900 hours on the first day of September). The last two digits of the year of origin may be added if required by national authorities.

dial central office - A switch at which communications between subscribers is effected without the intervention of an operator, by means of relays set in motion by the operation of a dial on the originating subscriber's instrument.

digital signal - A transmission in which information is represented by a series of discrete signal elements or digits (binary or other).

direct wave - A wave that travels directly between the transmitter and receiver antenna without reflections from any object.

display - The orderly presentation of information by communications-electronics means.

distortion - An undesired change in the waveform of the original signal. Distortion may exist in the amplitude, frequency, or phase of the waveform.

diversity system - A system of communications in which a single received signal is derived from a combination of, or selections from, a plurality of transmission channels or paths.

DRAGON - The M47 Dragon is a command-to-line-of-sight-guided, medium, antiarmor assault weapon system. Fired from a recoilless, disposable launcher, the missile is tracked optically and guided automatically through a wire link.

DRYAD - The unclassified term used to describe the numerical cipher/authentication system.

dual-hatted position - One officer assigned to serve in two separate areas of responsibility. (In this manual, it is used to refer to an individual serving as a C-E staff officer and signal unit commander.)

duplex operation - Duplex (or full Duplex) operation refers to communication between two points in both directions simultaneously.

-E-

Electromagnetic Compatibility (EMC) - The ability of communications-electronic equipments, subsystems, and systems to operate in their intended operational environments without suffering or causing unacceptable degradation because of unintentional electromagnetic radiation or response.

electromagnetic emission control - The control of friendly electronic emissions (e.g., radio, radar, and sonar transmissions) for the purpose of preventing or minimizing their use by unintended recipients.

electromagnetic environment - This is the environment in which communications and noncommunications emitters operate.

electromagnetic interference - Any electromagnetic disturbance which interrupts, obstructs or otherwise degrades or limits the effective performance of communications or noncommunications equipments. It can be induced intentionally, as in some forms of electronic warfare, or unintentionally, as a result of spurious emissions or responses, intermodulation products, etc.

Electronic Counter-Countermeasures (ECCM) - That division of EW involving actions taken to insure friendly effective use of the electromagnetic spectrum.

Electronic Countermeasures (ECM) - That major subdivision of electronic warfare involving actions taken to prevent or reduce the effectiveness of enemy equipment and tactics employing or affected by electromagnetic radiations, and to exploit the enemy's use of such radiations.

electronic deception - The deliberate radiation, reradiation, alteration, absorption or reflection of electromagnetic energy in a manner intended to mislead an enemy in the interpretation of use of information received by his electronic systems. There are two categories of deception: manipulative and imitative.

electronic emission security - Those measures taken to protect all transmissions from interception and electronic analysis.

electronic intelligence - The intelligence information product of activities engaged in the collection and processing, for subsequent intelligence purposes, of foreign, noncommunications, electromagnetic radiations emanating from other than nuclear detonations and radioactive sources.

electronic jamming - The deliberate radiation, reradiation, or reflection of electromagnetic energy with the object of impairing the use of electronic devices, equipment or systems being used by an enemy.

electronic search - A search of the electromagnetic spectrum, or portions thereof, in order to determine the existence, sources and pertinent characteristics of electromagnetic radiations.

Electronic Security (ELSEC) - The protection resulting from all measures designed to deny unauthorized persons information of value which might be derived from their interception and study of noncommunications electromagnetic radiation.

Electronic Warfare (EW) - That division of the military use of electronics involving actions taken to prevent or reduce an enemy's effective use of radiated electromagnetic energy, and actions taken to insure our own effective use of radiated electromagnetic energy.

Electronic Warfare Support Measures (ESM) - That division of EW involving actions taken to search for, intercept, locate, record and analyze radiated electromagnetic energy, for the purpose of exploiting such radiations in support of military operations. Thus, ESM provides a source of EW information required to conduct electronic countermeasures (ECM), electronic counter-countermeasures (ECCM), threat detection, warning, avoidance, target acquisition and homing.

encode - To convert a plain text message into unintelligible language by means of a cipher system.

engineering - The establishment, operation, maintenance and control of a communications system.

engineering circuit - An auxiliary circuit or channel for use by operating and maintenance personnel for communications incident to the establishment, operation, maintenance, and control of communications facilities. (An engineering circuit includes the functions of an *orderwire.*)

-F-

facsimile - A system of telecommunication for the transmission of fixed images with a view to their reception in a permanent form.

fading - A variation in strength of received signals due to variations, with time, in the conditions of propagation.

fixed plant - A permanently emplaced C-E facility.

four-wire circuit - A circuit using two pairs of conductors.

frequency - The number of recurrences of a periodic phenomenon in a unit of time. In specifying electrical frequency, the unit of time is the second, the frequency is expressed in hertz (Hz) (meaning cycle(s) per second). Radio frequencies are normally expressed kilohertz (kHz) at and below 999 kilohertz, and in megahertz (MHz) above this frequency.

frequency assignment - The process of designating a radio frequency for use at a specific station or by a specific military unit under specified conditions of operation.

frequency division multiplex (FDM) - A multiplex system in which the available transmission frequency range is divided into narrower bands, each used for a separate channel.

-G-

ground (earth) - The term applied to any conductor common to a number of circuits and which serves to maintain a constant potential, or to provide a bond of very low impedance between the points of connection to it. In many cases, the earth itself is used as the conductor.

ground wave - In propagation, that portion of the transmitted radio wave that travels near the surface of the earth.

gun ship - An unofficial term for the armed helicopter.

-H-

half-duplex operation - A telegraph system capable of operating in either direction, but not in both directions simultaneously. It's also called simplex.

hertz - A unit of frequency eqivalent to one cycle per second.

homing - A process whereby a mobile station is directed (or directs itself) towards a source of radio, radar, or other electromagnetic energy.

-I-

imitative electronic deception - The intrusion on the enemy's channels and the introduction of matter in imitation of his own for the purpose of deceiving or confusing him.

interception - The act of searching for and listening to and/or recording communications and electronic transmissions for the purpose of obtaining intelligence.

intercom - A telephone apparatus by means of which personnel can talk to each other within a signal center, an aircraft, tank, ship or activity.

interface - A point common to two or more systems or other entities across which useful information flow takes place.

interference - Any electrical disturbance which causes undesirable responses in electronic equipment.

Internal Defense And Development (IDAD) - Any direct operation undertaken by a host government or its allies to strengthen the local government politically, economically, socially, or militarily, or make more viable its national life.

ionosphere - The region of the atmosphere, extending from roughly 40 to 250 miles altitude, in which there is appreciable ionization. The presence of charged particles in this region profoundly affects the propagation of electromagnetic radiations of long wavelengths.

ionospheric scatter - The propagation of radio waves by scattering as a result of irregularities or discontinuities in the ionization of the ionosphere.

-J-

jamming - See electronic jamming.

joint - Connotes activities, operations, organizations, etc., in which elements of more than one service of the same nation participate.

Julian Time - A 7-figure group, in which the first 3 figures indicate the day of the year and the last 4 figures the time in hours and minutes.

Examples: 0900 hrs on 1 Jan is 0010900. 2200 hrs on 31 Dec is 3652200.

Note: Julian time is always GMT (ZULU time).

The time zone suffix is not used.

-K-

key list - A publication containing the key for a particular cryptosystem in a given cryptoperiod.

-L-

LASER - Light Amplification by Stimulated Emission of Radiation. A device that utilizes the natural oscillations of atoms for amplifying or generating electromagnetic waves in the region of the spectrum from the ultraviolet to the far-infrared, including the visible region.

LAW - The M72A2 (Light Antiarmor Weapon) is a close-in, lightweight, smoothbore, percussion-fired antiarmor weapon which is designed to give the individual infantryman the capability of defeating armored vehicles.

link - A general term used to indicate the existence of communications facilities between two points.

local loop - A circuit connecting an end instrument to a switching facility or distribution point.

log, circuit - A chronological record of events relating to the operation of a particular circuit.

log, station - A chronological record of station events; i.e., entries relating to message handling, equipment difficulties, personnel, etc.

long lines - Long lines include all forms of physical conductors used for communication purposes such as open wire systems, underground and overhead cables, and submarine cables, but do not include local circuits. They may also contain radio relay systems when they are integrated with the wire system.

-M-

manipulative electronic deception - The use of friendly electromagnetic radiations so as to falsify the information which a foreign nation can obtain from their analysis.

manual central office - A switch in which the lines are connected to a switchboard and interconnections are controlled by an operator.

message - Any thought or idea expressed briefly in a plain, coded or secret language, prepared in a form suitable for transmission by any means of communication.

message, service - A brief, concise message between operating or supervisory personnel at telecommunications centers or relay stations pertaining to any phase of traffic handling, status of communication facilities, circuit conditions, or other matters affecting communication operations.

MIJI Report (Meaconing, Intrusion,Jamming, Interference) - A report to a higher headquarters of an incident of interference in the reception of radio signals.

minimize - A condition wherein normal messages and telephone traffic is drastically reduced, in order that messages connected with an actual or simulated emergency will not be delayed.

mobilization - The process by which the armed forces or part of them are brought to a state of readiness for war or other national emergency. This includes assembling and organizing personnel, supplies and materiel for active military service.

modulation - The process in which the amplitude, frequency or phase of a carrier wave is varied with time in accordance with the waveform of a superimposed intelligence.

monitoring - The act of listening to, reviewing, and/or recording one's own or (by special agreement) other friendly forces' communications for the purpose of maintaining and improving standards of communications security or efficiency, or for reference.

MOS (Military Occupational Speciality) - A term used to identify a grouping of duty positions possessing such close occupational or functional relationship that an optimal degree of interchangeability among persons so classified exists at any given level of skill.

multi-axis - More than one line along which communications takes place.

multi-means - More than one method or system over which a message can be transmitted.

multiplex - Denotes the simultaneous use of a number of channels on a single circuit.

-N-

net - An organization of stations capable of direct communications with each other using a common frequency or channel.

net call sign - A call sign which represents all stations within a net.

Net Control Station (NCS) - A station designated to control traffic and enforce circuit discipline within a given net.

network - *Communication term.* - An organization of stations capable of intercommunication but not necessarily on the same channel. *Engineering term.* - Two or more interrelated circuits.

noise - Any undesired sound. By extension, noise is any unwanted disturbance, such as undesired electromagnetic waves in any transmission channel or device. Cross talk, distortion products and intermodulation products are sometimes classed as noise.

-O-

on-the-job training - A training process whereby students or trainees acquire knowledge and skills through actual performance of duties under competent supervision, in accordance with an approved, planned program.

operational readiness training - That phase of training undertaken by units which have completed the formal phases of training and which are assigned the responsibility for maintaining the highest possible state of combat proficiency in order to accomplish operational missions.

operation order - A directive, usually formal, issued by a commander to subordinate commanders for the purpose of effecting the coordinated execution of an operation.

originator - The command by whose authority a message is sent. The originator is responsible for the functions of the drafter and releasing officer.

-P-

page copy - A message in page form which is the result of a transmission.

panel code - A prearranged code designed for visual communications between ground units and friendly aircraft.

phantom circuit - A telephone or telegraph circuit obtained by superimposing an additional circuit on two existing physical circuits by means of repeating coils.

plain text - Intelligible text or signals which have meaning and which can be read or acted upon without the application of any decryption.

POL - Petroleum, oil and lubricants.

precedence - A designation, assigned to a message by the originator, to indicate to communications personnel the relative order of handling, and to the addressee the order in which the message is to be noted.

preventive maintenance (PM) - The care and servicing by personnel for the purpose of maintaining equipment and facilities in satisfactory operating condition by providing for systematic inspection, detection, and correction of failures either before they occur or before they develop into major defects.

procedure sign (PROSIGN) - One or more letters or characters or combination thereof used to facilitate communications by conveying, in a condensed standard form, certain frequently used orders, instructions, requests and information related to communications.

procedure word (PROWORD) - A word or phrase limited to radio telephone procedure and used in lieu of a prosign.

pulse code modulation - Pulsed modulation in which the signal is sampled periodically and each sample is quantized and transmitted as a digital binary code.

pyrotechnics - Ammunition containing chemicals that produce a smoke or brilliant light in burning, used for signaling or for lighting up an area at night.

-Q-

quantization - A process in which the range of values of a wave is divided into a finite number of distinct subranges (called quanta), not necessarily equal, each of which is represented by an assigned or "quantized" value within the subrange.

-R-

radio direction finding (RDF) - Radio location in which only the direction of a station is determined by means of its emission. Since this technique can be used against all electronic emitters, it is sometimes simply referred to as direction finding (DF).

radio listening silence - Designated radio stations are instructed to monitor their receivers for incoming traffic but not to transmit for a specified period or until further ordered.

radio relay system - A radio transmission system in which the signals are received and transmitted from point to point by intermediate radio stations. This system, normally used in conjunction with carrier equipment, provides channels for both voice and teletypewriter operations.

radio silence - A period during which all or certain radio equipment capable of radiation is kept inoperative.

radio teletypewriter (RATT) - The system of communication by teletypewriter over radio circuits.

radio wire integration (RWI) - The interconnection of wire circuits with radio facilities.

readability - The ability to be understood, i.e., the readability of signals sent by any means of telecommunications.

reception - Listening to, copying, recording or viewing any form of emission.

REDEYE - A man-transportable guided missile, fired from the shoulder, designed to provide combat troops with the capability of destroying low-flying aircraft. Designated as XM-41.

releasing officer - The person who may authorize the transmission of a message for, and in the name of, the originator.

requirements density overlay - A transparent sheet bearing unit locations and C-E requirements, designed to emphasize the geographical density of C-E requirements when superimposed on a map.

retransmission - Employment of a radio communication set for the purpose of rebroadcasting a message on a different frequency simultaneously with the original broadcast by means of an electrically operated linkage device between the receiver and transmitter of the set.

ringing frequency - A signal of proper frequency sent out from a switchboard or other instrument to notify a distant terminal of a call.

routing - The process of determining and prescribing the path or method to be used in forwarding messages.

routing indicator - A group of letters assigned to identify a station within a tape relay network to facilitate routing of traffic. It indicates the status of the station and may indicate its geographical area. Routing indicators are composed in accordance with the routing indicator plan described in the ACP 121 series.

-S-

sampling - Of a signal. A process in which a continuous signal is approximately represented by a series of discrete values, usually regularly spaced.

sideband - The frequency band, above or below the carrier, produced by the process of modulation. *Double sideband (DSB).* - That method of communication in which the frequencies produced by the process of modulation are symmetrically spaced both above and below the carrier frequency and are all transmitted. *Single sideband (SSB).* - That system of carrier transmission in which one sideband is transmitted and the other suppressed. The carrier wave may be either transmitted or suppressed. *Independent sideband (twin sideband) (ISB).* - That method of communication in which the frequencies on opposite sides of the carrier, produced by the process of modulation, are not related to each other but are relocated separately to two sets of modulating signals. The carrier frequency may be transmitted, suppressed or partially suppressed.

signal center - See area and command signal centers.

signal intelligence (SIGINT) - The final product resulting from collection, evaluation, analysis, integration, and interpretation of information gathered from hostile electronic emitters. It includes communications intelligence (COMINT) and electronic intelligence (ELINT) and is used in determining enemy order of battle and planning future operations.

simplex operation - The operation of a circuit permitting communications in only one direction at a time; half duplex.

sole-user circuit (point-to-point) - A circuit from one subscriber to another subscriber on a fixed path.

space (spacing signal) - One of the two types of impulses used in teletypewriter transmission; normally that impulse during which no current flows through the teletypewriter selector magnet.

spot jamming - The jamming of a specific channel or frequency.

squelch - The reduction or elimination of the noise otherwise heard in a radio receiver when no carrier signal is present.

standing operating procedure (SOP) - A set of instructions covering those features of operations which lend themselves to a definite or standardized procedure without loss of effectiveness.

strategic telecommunications - Continental, intercontinental and intercommand telecommunications facilities and services that are owned, leased, operated or controlled by the Department of the Army, which provide a means for the exercise of command and control, and logistic and administrative support of elements of the Department normally assigned down to the Army component commander within the theater of operations, and other Department of Defense and Governmental agencies as directed.

strip map - A map showing only a narrow geographical area between one point and another.

switchboard - An apparatus on which the various circuits from subscribers and other switchboards are terminated to enable communications either between two subscribers on the same switchboard or between subscribers on different switchboards.

synchronization - Identity in frequency (or time) and correspondence in phase between like processes at two or more points in a system.

system control - An engineering center within a telecommunications system at which technical control of facilities is exercised. See also Communications System Control Element.

system controller - An individual at a technical system control point who is responsible for maintaining quality control and channel switching of telecommunications.

-T-

Table of Organization and Equipment (TOE) - A table which prescribes the normal mission, organizational structure, personnel, and equipment requirements for a military unit and is the basis for an authorizations document.

tactical communications - Communications provided by, or under the operational control of, commanders of combat forces, combat troops, combat support troops, or forces assigned a combat service support mission.

Tactical Operations Center (TOC) - A facility from which selected special or general staff members assist in the direction, coordination, and control of current combat operations.

tandem switch - A switch used primarily as a switching point for traffic between other switches.

tape relay - A method of receiving and retransmitting messages in tape form.

telecommunications - Any transmission, emission or reception of signals, signs, writings, images, sounds, or information of any nature by wire, radio, visual, or other electromagnetic systems.

telecommunications center - An agency charged with the responsibility for acceptance, preparation for transmission, receipt, duplication and delivery of messages.

text - That part of a message which contains the thought or idea which the originator desires to be communicated.

time division multiplex (TDM) - A multiplex system in which the total available circuit time is divided between the number of channels to be transmitted.

TOW (Tube launched, Optically tracked, Wire command link) guided missile - The heavy antiarmor weapon system.

traffic (communication) - All transmitted and received messages.

traffic control point - A point where military police personnel regulate the flow of traffic to insure the orderly flow of traffic into and out of an area.

tropospheric scatter - The propagation of radio waves by scattering as a result of irregularities or discontinuities in the physical properties of the troposphere.

trunk circuit - A circuit directly connecting two distant central offices.

two-wire circuit - A circuit formed of two conductors.

-V-

verify - To insure that the meaning and phraseology of the transmitted message conveys the exact intention of the originator.

voice frequency - Any frequency within the part of the audio frequency range essential for the transmission of speech of commercial quality, i.e., 300-3000 Hz.

voice frequency telegraphy (VFTG) - Telegraphy using one or more carrier frequencies within the voice frequency range.

-W, X, Y, Z-

waveguide - A hollow structure, usually of rectangular cross section, used to transmit radio frequency energy over limited distances; e.g., from radar transmitter to antenna.

wavelength - A wavelength is the distance traveled in one period or cycle by a periodic disturbance. It is the distance between points of corresponding phase of two consecutive cycles. Wavelength is equal to the velocity divided by the frequency.

Appendix C — Sample C-E Diagrams

1. Mission:

To provide communications support for the 52d Mechanized Division during its defense of the Vistula River. Be prepared to provide communications support for a passage of lines by the 25th Armored Division.

2. Situation and Courses of Action:

a. Area of Operations.

(1) Terrain. Generally low, rolling mountains descending towards the Vistula River. The road network is adequate, though not elaborate. Trafficability is excellent except in the swampy areas along the Vistula River.

(2) Weather. Fair with frequent rain storms. Temperatures from 70 to 90 degrees with moderate westerly winds.

(3) Existing communications. No information on existing facilities.

b. Enemy Situation. Capable of limited nuclear strikes and conventional air strikes. No guerrilla activity has been noted, and enemy EW capability is assured to be sophisticated. Additional information can be obtained from the EWO.

c. Own Situation. Normal division troop at 95 percent strength. Maintenance problems with generators will limit employment of radio relay.

d. Courses of Action.

(1) Tactical radio (AM-FM).

(2) Multichannel

(3) Wire and cable.

(4) Messenger.

3. Analysis of Opposing Courses of Action:

a. Tactical Radio.

(1) Easy to install.

(2) Flexible.

(3) Airborne relays probable.

(4) Highly vulnuerable to EW (intercept, DF, jamming, and imitative communications deception ICD).

(5) Relatively easy to conceal stations and antennas.

b. Multichannel.

(1) Installation is reasonably fast.

(2) Reliable and flexible once installed.

(3) Vulnerable to enemy EW.

(4) Difficulties with power equipment will limit deployment.

(5) Stations, especially the antennas, are hard to conceal.

c. Wire and cable.

(1) Suited for defensive posture.

(2) Security good.

(3) Slow installation.

d. Messenger.

(1) Air and ground capability appears excellent.

(2) Security excellent.

(3) Flexible - reliable.

(4) Slow.

4. Comparison of Own Courses of Action:

a. Radio

(1) No power problems as experienced with multichannel.

(2) Faster than messenger.

(3) More flexible than wire.

(4) Most vulnerable to enemy EW.

b. Multichannel.

(1) Power problems will limit its usefulness.

(2) Less vulnerable to EW than radio.

(3) Less secure than messenger.

(4)Faster than messenger and wire.

c. Wire and Cable.

(1) Once installed it is more reliable than radio or radio relay.

(2) Less vulnerable to EW than radio or multichannel.

(3) Faster than messenger.

d. Messenger.

(1) Most reliable means.

(2) Most secure means.

(3) More flexible than multichannel or wire.

(4) Slow.

5. Decision:

a. During movement into defensive positions messenger will be used extensively. Radio will be limited due to security requirements. Multichannel will be installed along route of march.

b. Once in defensive position, multichannel will supplement wire and cable as primary means of communication. Messengers will be used extensively. Radio will be restricted to preclude detection by the enemy of friendly troop concentration.

c. Any communications required for 25th Armored Division's passage through 52d Division will be provided by extension of established wire and cable and multichannel communications.

Appendix D — Sample C-E Annex

CLASSIFICATION

Copy No of Copies
52d Mech Div
Jelenia Gora (3348) POLAND
151730ZJuly 19__
PT 24

Annex E (Communications-Electronics) to OPORD 12

Reference: Map POLAND 1:100,000 LUBLIN
Time Zone Used Throughout Order: Zulu
1. SITUATION:

a. Enemy Forces:
Annex A (Intelligence)

b. Friendly Forces:

(1) See Task Organization OPORD 12

(2) Corps Signal Brigade furnished C-E from MONARCH 8156 to Division Support Command DIAMOND 7264.

c. Attachments and Detachments: None

2. MISSION:

Install, operate and maintain communications at the major subordinate elements of the 52d Mechanized Division during its defensive operations along the VISTULA RIVER.

3. EXECUTION:

a. Concept of Operation: Provide division communications-electronics per SOP for defense with minor changes indicated below. Initial emphasis on radio until located in position, thereafter, multichannel and cable.

b. 1st Bde: SOP

c. 2d Bde: SOP

d. 3d Bde: Provide AN/GRC-142 at GOP Headquarters.

e. Div Arty: SOP

f. 2/23 Cav: SOP for Economy of Force.

g. 152d Sig Bn:

(1) Provide AN/TRC-145 at Cav and GOP Headquarters.

(2) Tactical radios per Appendix 1.

(3) Other units SOP.

CLASSIFICATION

h. Coordinating Instructions:

(1) Listening silence on all radio nets upon establishment of multichannel systems, except for units in contact or as specified by DCEO.

(2) Signal Centers:

(a) Effective time operations - 151900ZJuly 19__.

(b) Messenger routes and schedule, Appendix 9, effective 160600ZJuly 19__. Special messengers available upon request DCEO.

(c) VHF radio relay primary means when operational. Radio equipment on listening silence when cable installed-Appendix 3.

(d) Wire and cable primary means when installed-Appendix 8.

4. SERVICE SUPPORT:

Admin Order No. 5.

5. COMMAND AND SIGNAL:

a. Signal.

(1) CEOI INDEX 1-6 in effect.

(2) I Corps CEOI INDEX 1-2 in effect.

(3) DCEO located at Division Main CP.

b. Command.

(1) Division Main CP (JG 3348).

(2) Units report CP locations.

Appendices:

1 - Radio Net Diagram (FM)
2 - Radio Net Diagram (RATT)
3 - Radio Net Diagram (Multichannel)
4 - Multichannel Systems Diagram Format
5 - Circuit Diagram Format
6 - Tape Relay Traffic Diagram
7 - Line Route Map
8 - Initial Location of Signal Centers
9 - Initial Messenger Routes

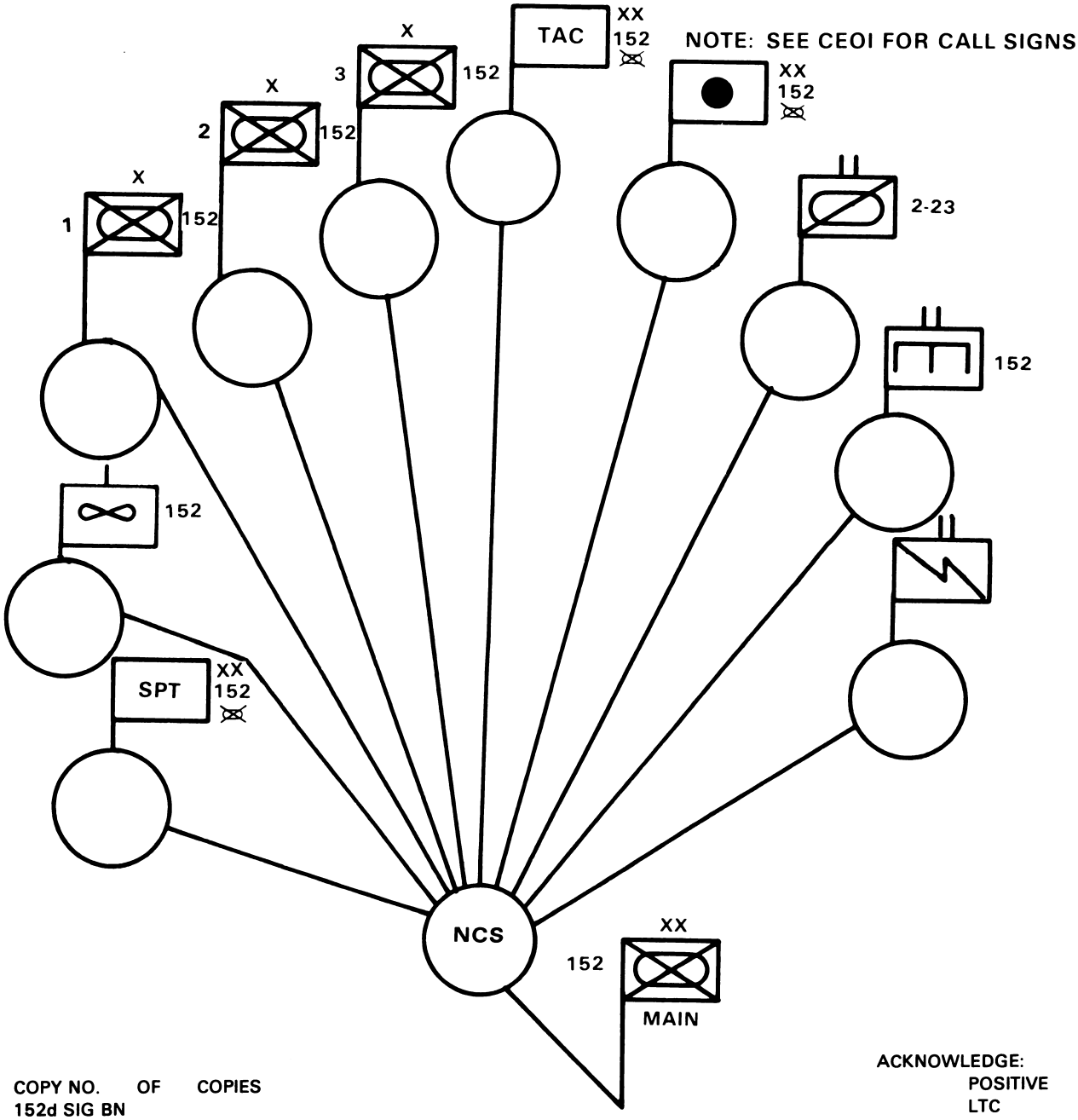
OFFICIAL:

/s/Response
RESPONSE
G3

Appendix E — Sample C-E Diagrams

CLASSIFICATION

DIVISION COMMAND/OPERATIONS NET (FM)



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152d SIG BN
LOCATION
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APPENDIX 1
TO ANNEX E
TO OPORD 12 —(year)

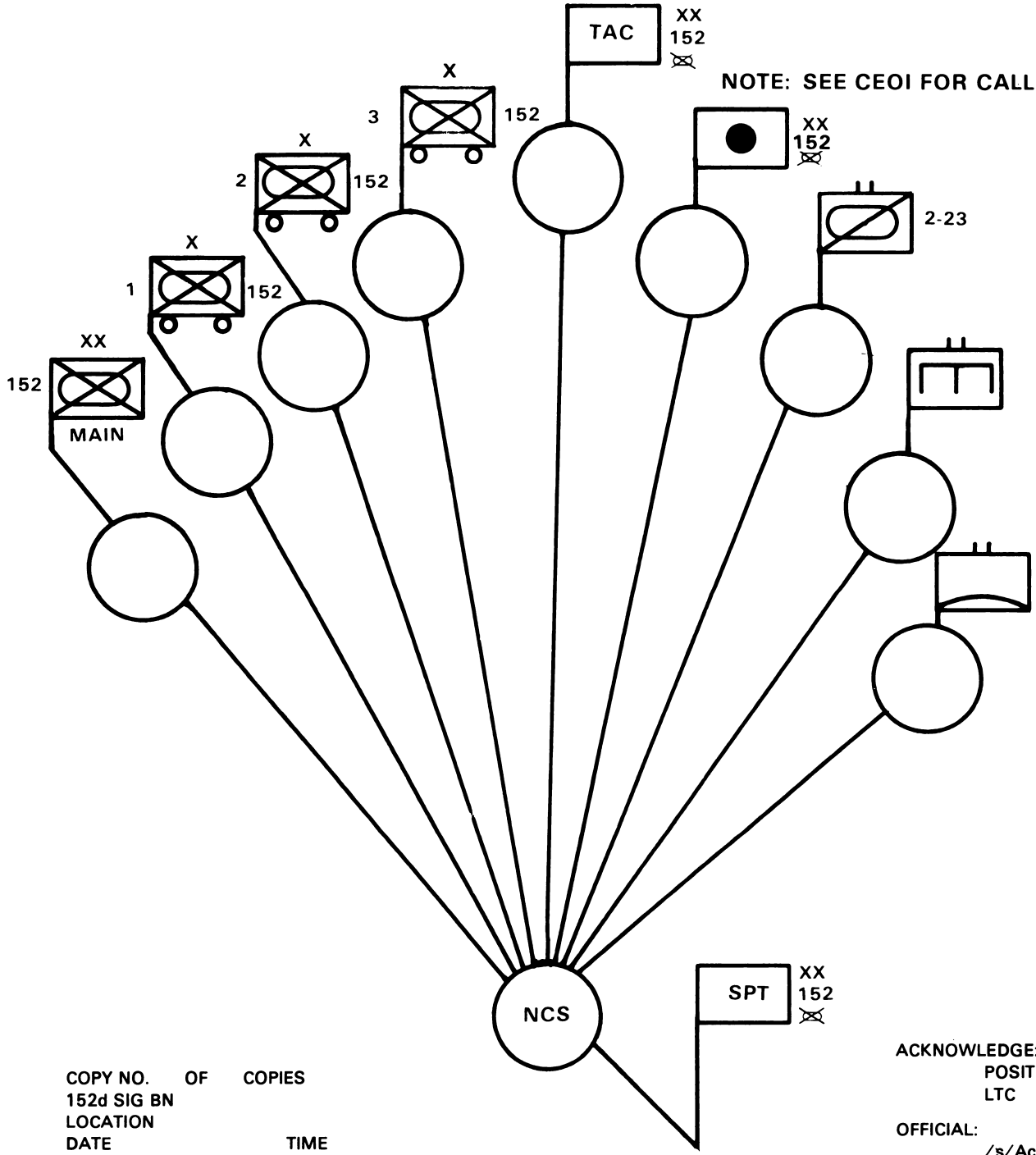
ACKNOWLEDGE:
POSITIVE
LTC

OFFICIAL:
/s/Action
ACTION

DISTRIBUTION: A

CLASSIFICATION

DIVISION ADMIN-LOG NET (RATT)



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APPENDIX 2
TO ANNEX E
TO OPORD 12 —(year)

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OFFICIAL:
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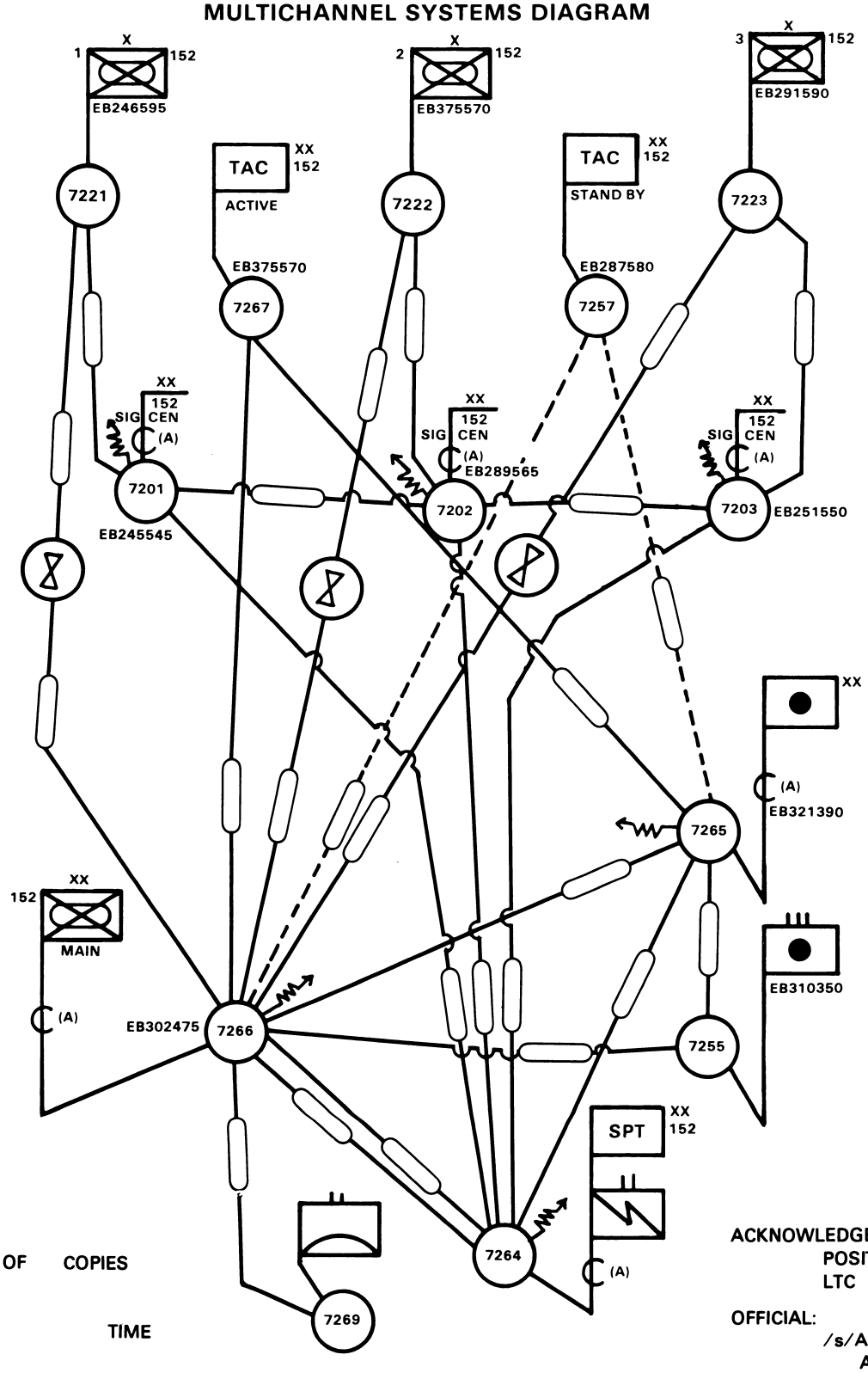
ACTION

DISTRIBUTION: A

MULTICHANNEL SYSTEMS DIAGRAM



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APPENDIX 3
TO ANNEX E
TO OPORD 12 —(year)

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OFFICIAL:
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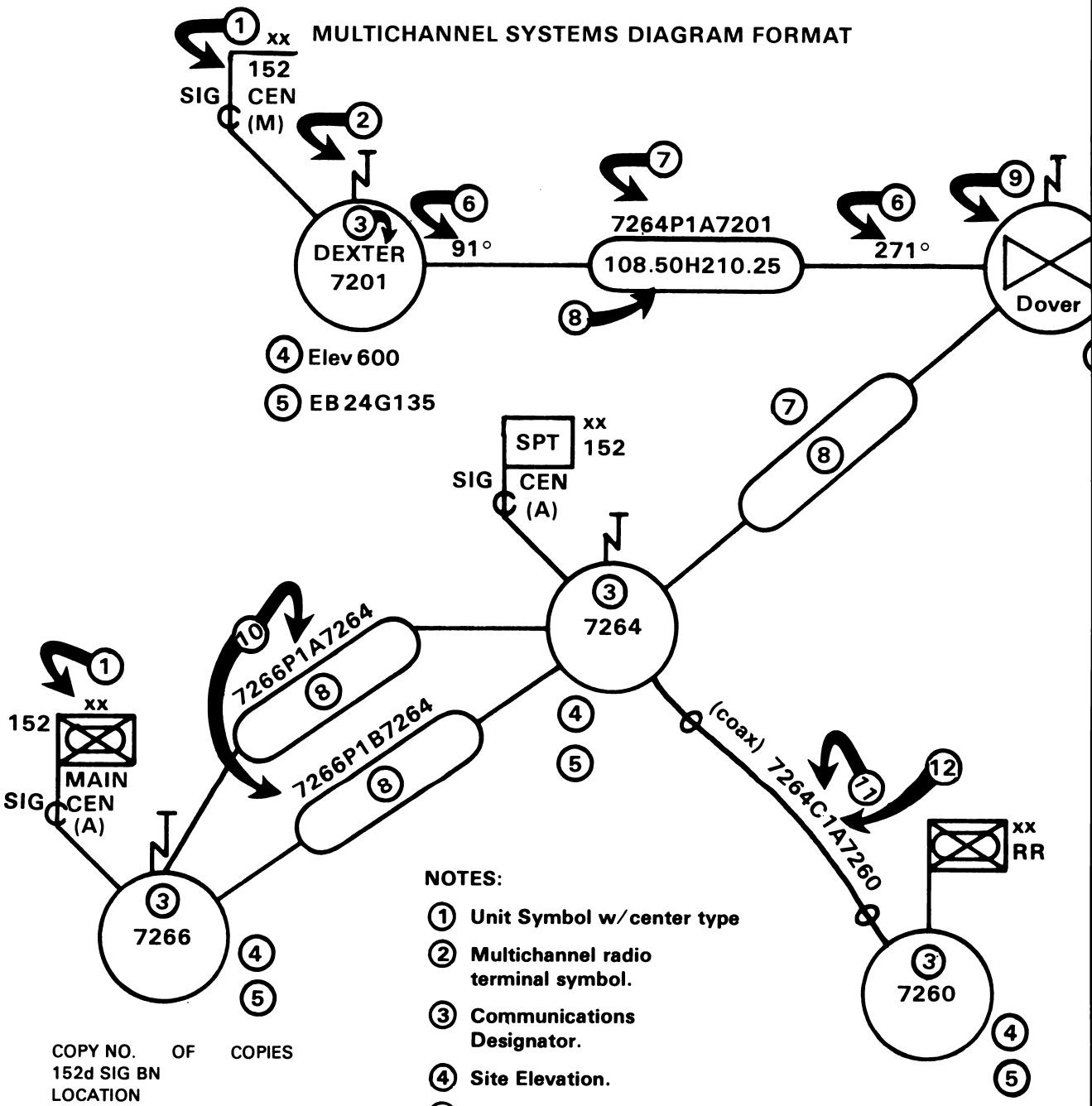
DISTRIBUTION: A

MULTICHANNEL SYSTEMS DIAGRAM FORMAT



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APPENDIX 4
TO ANNEX E
TO OPORD 12 —(year)

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LTC

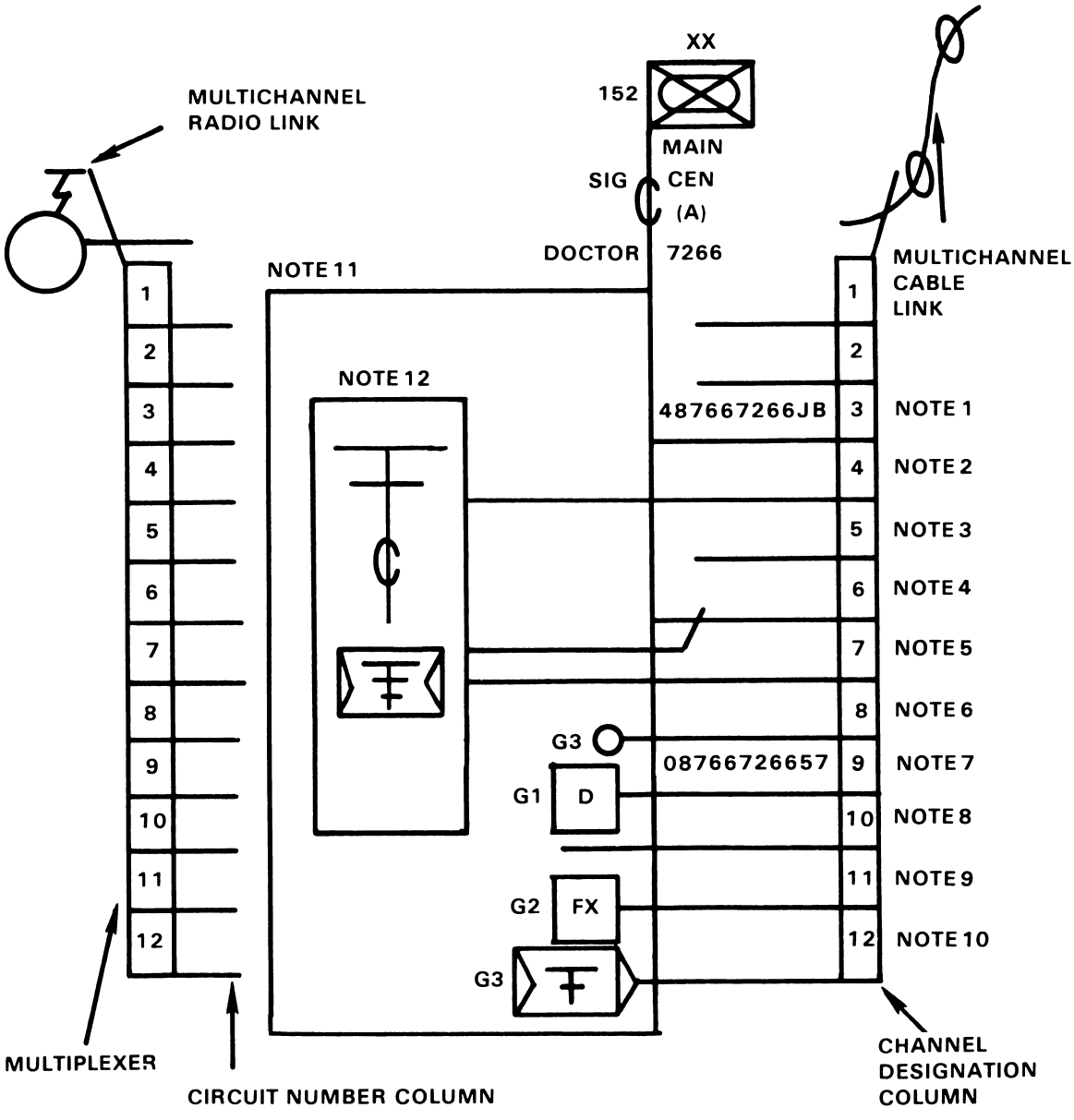
OFFICIAL:
/s/Action
ACTION

DISTRIBUTION: A

NOTES:

1. **Unit Symbol w/center type**
2. **Multichannel radio terminal symbol.**
3. **Communications Designator.**
4. **Site Elevation.**
5. **Site Coordinates.**
6. **Magnetic Azimuth.**
7. **Radio System Designator.**
8. **Frequency & Polarity of Antenna.**
9. **Radio Relay Symbol & Communications Designator.**
10. **Sample of two or more systems.**
11. **Cable system designator.**
12. **Number of 12 channel groups on system.**

CIRCUIT DIAGRAM FORMAT



Note 1: Common-user telephone with sample circuit number.
Note 2: Common-user teletypewriter.
Note 3: Spare channel.
Note 4: Speech plus half duplex circuit.
Note 5: Point-to-point (sole-user teletypewriter) within the TCC.
Note 6: Point-to-point (sole-user telephone).
Note 7: Point-to-point (sole-user data circuit) with circuit number.
Note 8: Strap-thru channel.
Note 9: Point-to-point (Facsimile).
Note 10: Point-to-point (sole-user teletypewriter).
Note 11: Outer rectangle edge represents a telephone switchboard.
Note 12: Inner rectangle edge represents a teletypewriter switchboard within a telecommunications center (TCC).

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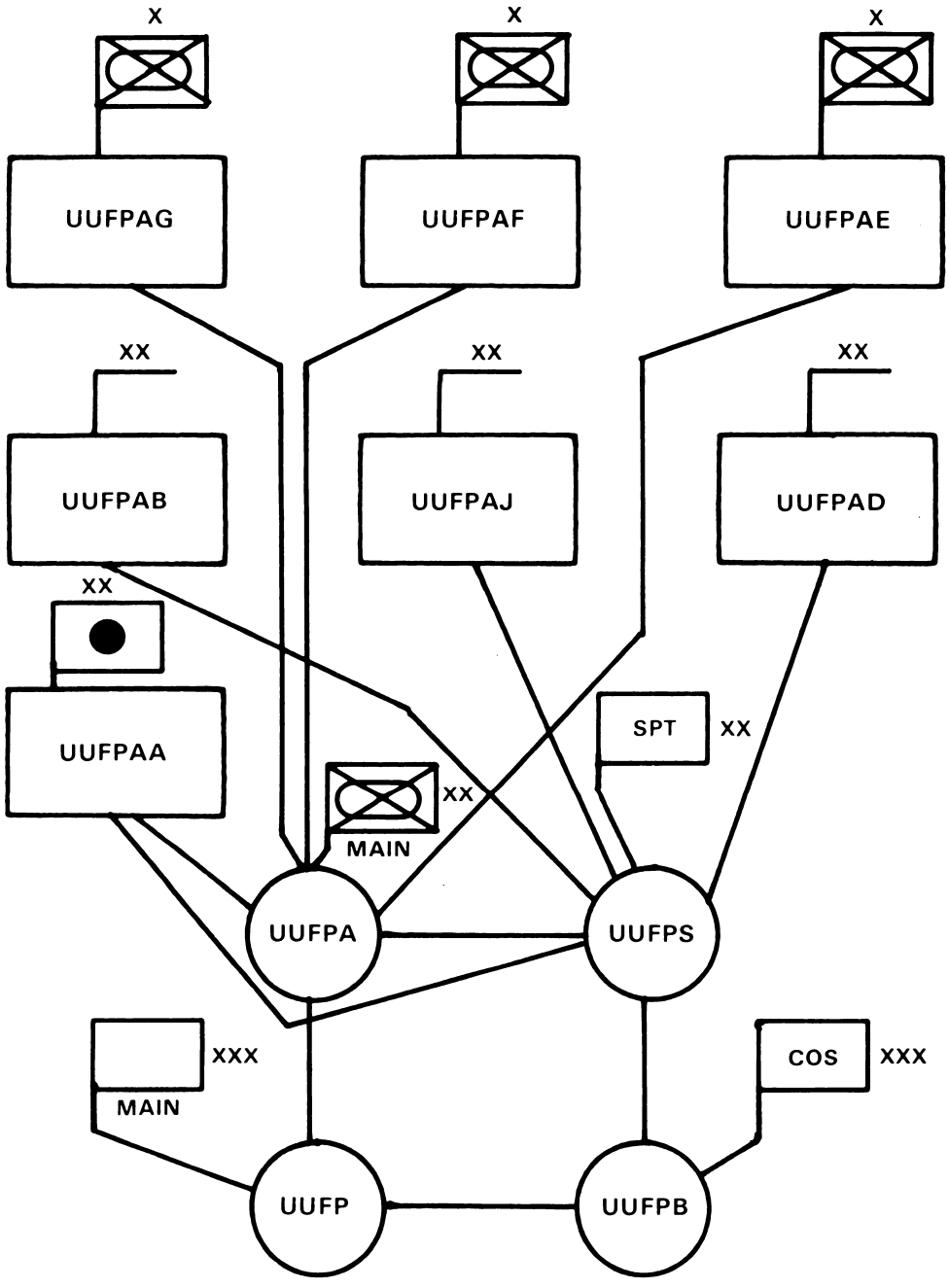
APPENDIX 5
TO ANNEX E
TO OPORD 12 —(year)

ACKNOWLEDGE:
POSITIVE
LTC

OFFICIAL:
/s/Action
ACTION

DISTRIBUTION: A

TAPE RELAY TRAFFIC DIAGRAM



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APPENDIX 6
TO ANNEX E
TO OPORD 12 —(year)

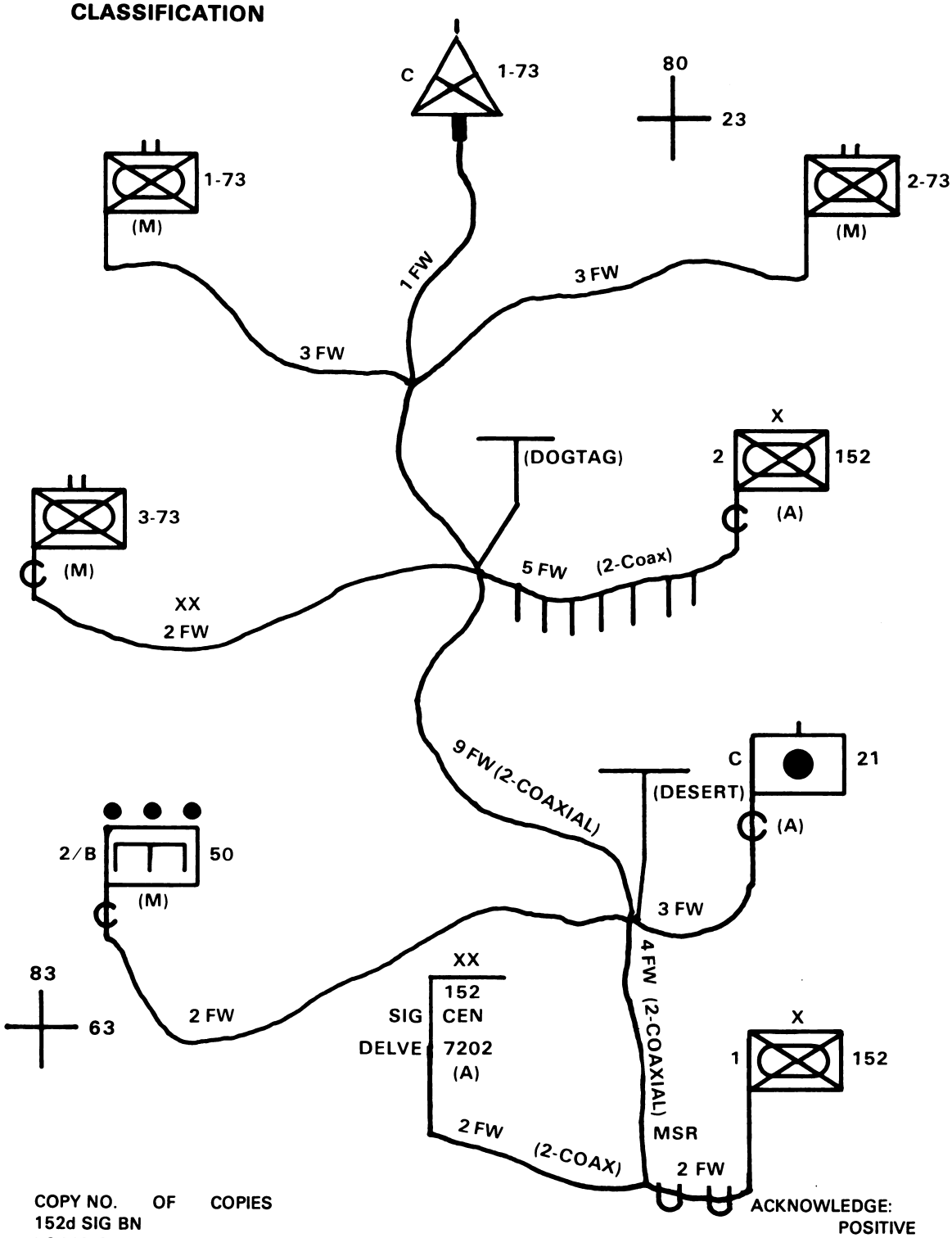
ACKNOWLEDGE:
POSITIVE
LTC

OFFICIAL:
/s/Action
ACTION

DISTRIBUTION: A

CLASSIFICATION

LINE ROUTE MAP



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DATE TIME
APPENDIX 7
TO ANNEX E
TO OPORD 12 —(year)

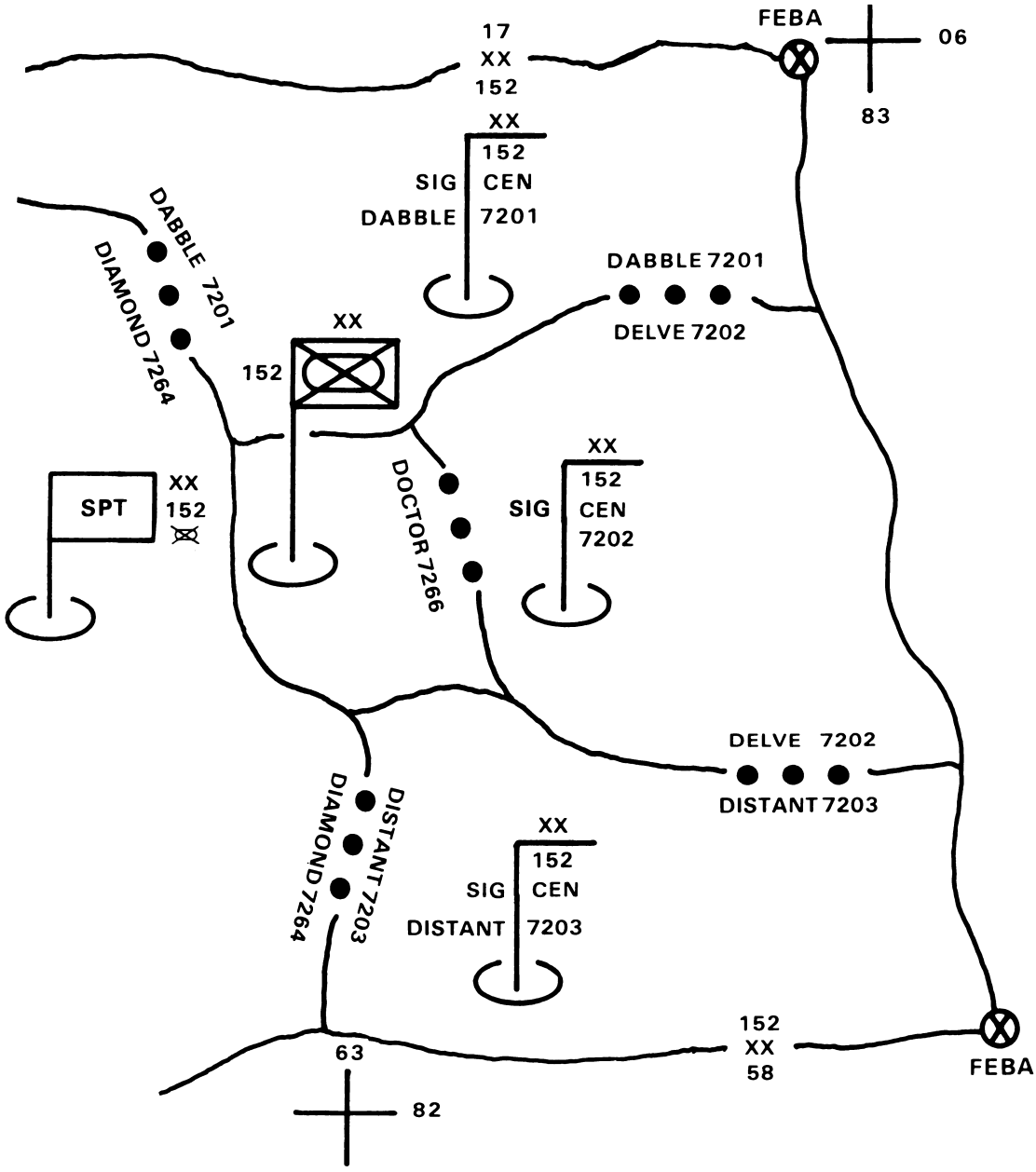
ACKNOWLEDGE:
POSITIVE
LTC

OFFICIAL:
/s/Action
ACTION

DISTRIBUTION: A

CLASSIFICATION

INITIAL LOCATION OF SIGNAL CENTERS



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APPENDIX 8
TO ANNEX E
TO OPORD 12 —(year)

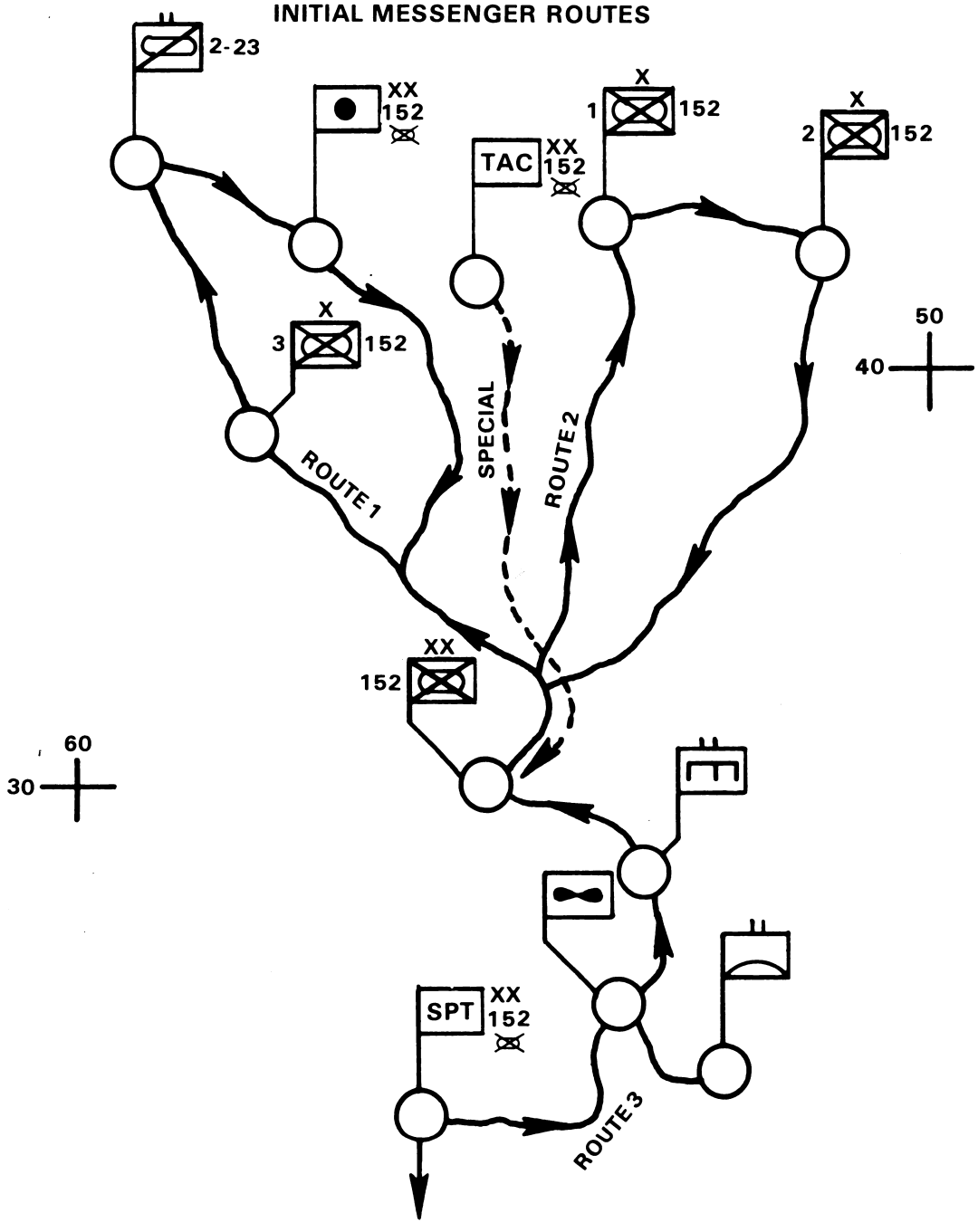
ACKNOWLEDGE:
POSITIVE
LTC

OFFICIAL:
/s/Action
ACTION

DISTRIBUTION: A

CLASSIFICATION

INITIAL MESSENGER ROUTES



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LOCATION
DATE TIME
APPENDIX 9
TO ANNEX E
TO OPORD 12 —(year)

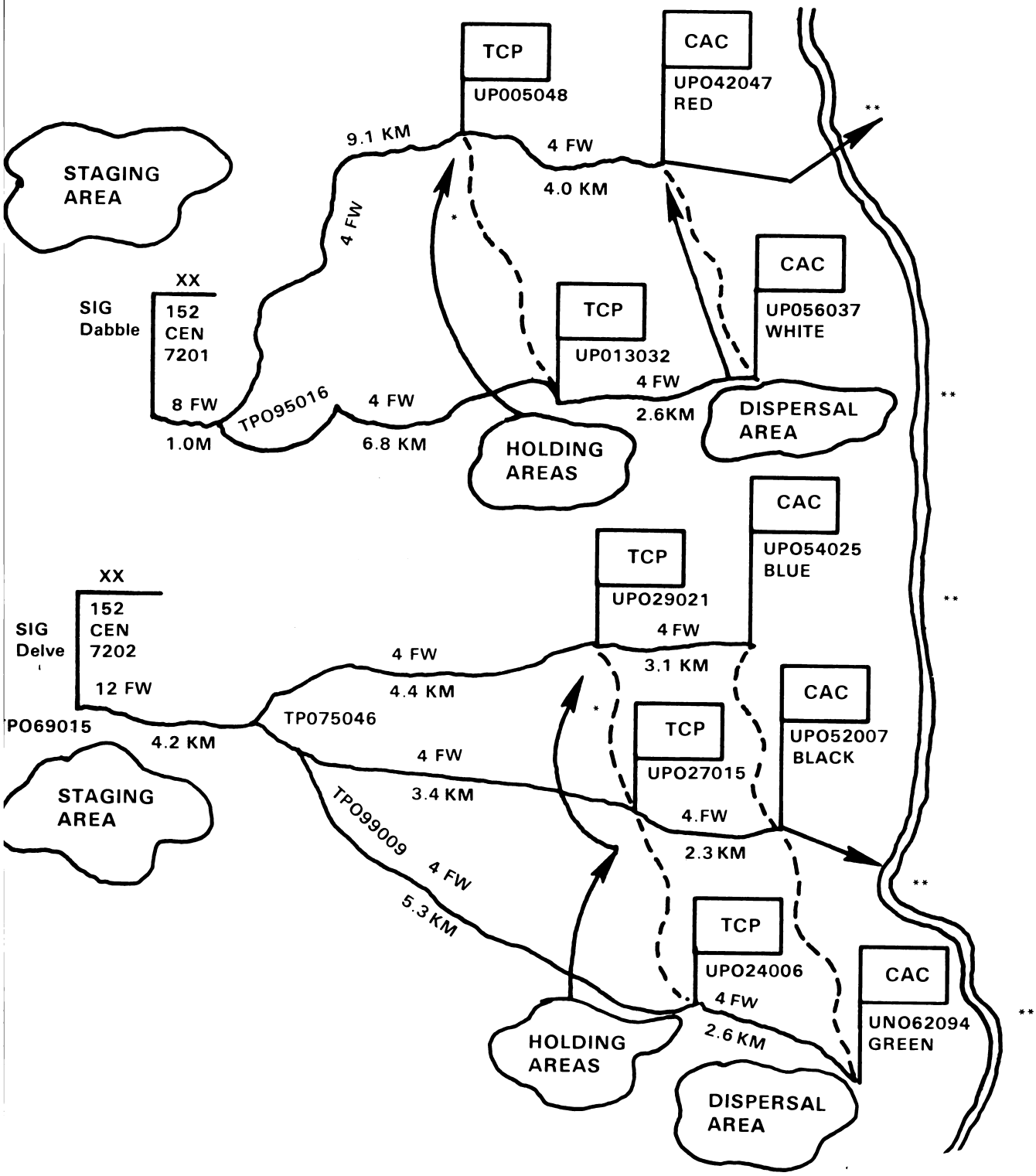
ACKNOWLEDGE:
POSITIVE
LTC

OFFICIAL:
/s/Action
ACTION

DISTRIBUTION: A

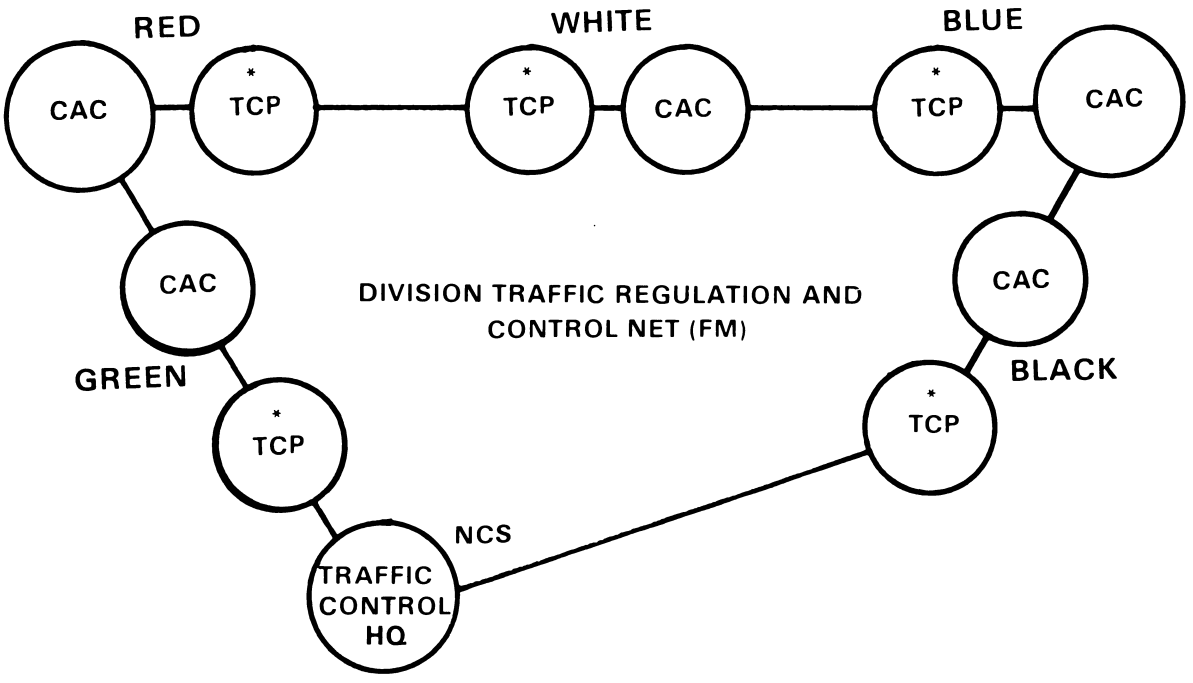
CLASSIFICATION

Appendix F — River Crossing Communications Diagrams

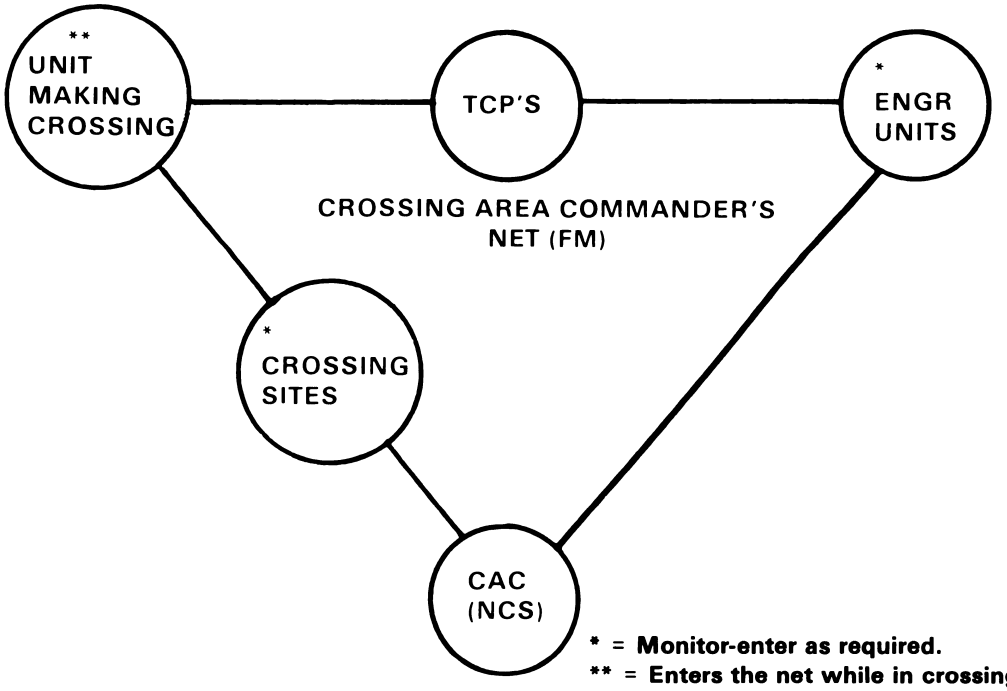


*Lateral lines if time permits.
*Wire extended to bridgehead as soon as possible.

CAC = Crossing area commander
TCP = Traffic control point

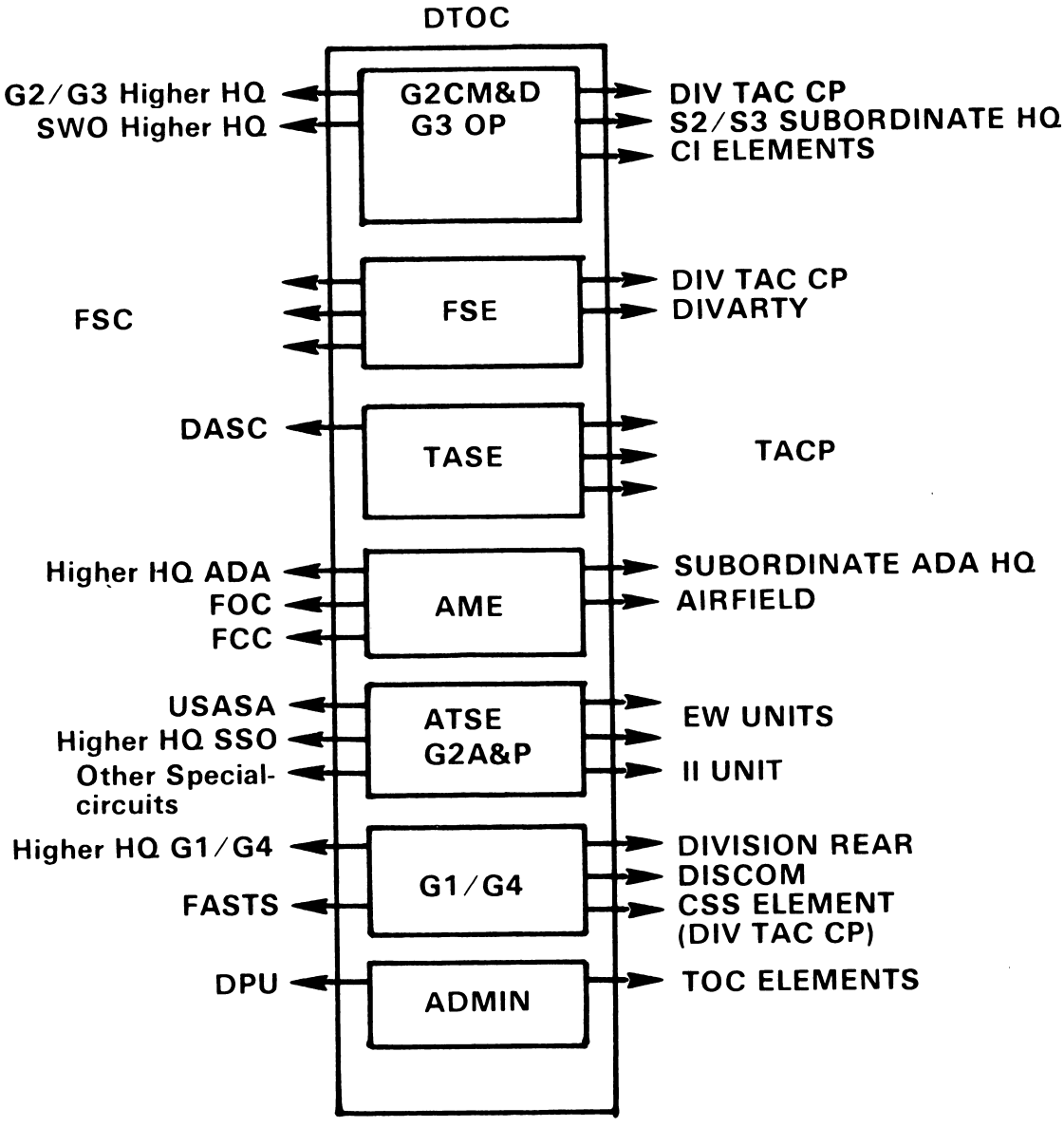


* = Monitor-enter as required.
** = Enters the net while in crossing area.



* = Monitor-enter as required.
** = Enters the net while in crossing area.

Appendix G — Sample Tactical Operations Center (TOC) Diagram for a Division



TOC ACRONYM LIST

ADA ..... Air Defense Artillery
ADMIN ..... Administration
AME ..... Airspace Management Element
ATSE ..... Army Security Agency Tactical Support Element
C-E ..... Communications-Electronics
CI ..... Counterintelligence
CSS ..... Combat Service Support
DASC ..... Direct Air Support Center
DPU ..... Data Processing Unit
ENGRE ..... Engineer Element
EW ..... Electronic Warfare
FCC ..... Flight Coordination Center
FDC ..... Fire Direction Center
FOC ..... Flight Operations Center
FSCC ..... Fire Support Coordination Center
FSE ..... Fire Support Element
HQ ..... Headquarters
II ..... Imagery Interpretation
NBCE Nuclear, Biological, Chemical Element
OP ..... Operations
PM ..... Provost Marshal
SSO ..... Special Security Officer
TACP ..... Tactical Air Control Party
TASE ..... Tactical Air Support Element
TOC ..... Tactical Operations Center
USASA United States Army Security Agency

Appendix H — Interference Report (For the Operator)

General. Reception of radio signals is often hindered, confused, or prevented by the interference of unwanted signals in the receiver. Such interference may be unintentional (from friendly or natural sources) or intentional (from unfriendly sources).

Definitions. The following types of interference may be experienced:

Meaconing - The transmission of false navigational signals to confuse or hinder navigation of aircraft and ships or to confuse ground stations.

Intrusion - The intentional insertion of radio signals into friendly transmissions to deceive or confuse friendly operations; i.e., imitative communications deception and imitative electronics deception.

Jamming - The deliberate obliteration or disruption of friendly use of a particular frequency or frequency spectrum. Jamming is intended to prevent or limit the use of the friendly communications system or device.

Interference - Any natural or manmade radiation of electrical energy that causes difficulty in the reception of signals. For the purpose of this discussion, interference is any unidentified radiation that causes an undesirable effect on friendly communications or noncommunications equipment.

Individual responsibility. The individual who experiences interference is responsible for insuring the incident is reported. Before initiating an interference report, however, the individual should disconnect the receiving antenna to insure the interference is from an external source. Electrical generators, overhead powerlines, and friendly equipment located nearby should be examined as possible causes of the interference. When he's satisfied that local corrective action will not eliminate the interference, the individual will take the actions outlined below.

Antijamming Measures. Antijamming measures have been designed to allow radio operators to work effectively through intentional interference. Regardless of the nature of the interfering signal, radio operations will *not* reveal in the clear the possibility or success of enemy jamming. When jamming is suspected, the following antijamming measures will be taken:

- Remain calm.
- Continue to operate.
- Do not admit to being jammed and observe radio discipline at all times.
- Adjust the fine tuning, gain (or volume) control, bandwidth selector, crystal filter, and other controls peculiar to the equipment being used.
- Increase transmitter power.
- Reorient or resite the antenna; or change antenna polarization.
- Reduce transmission speed.

If these measures are unsuccessful, the operator should attempt to contact the C-E officer on the frequency assigned for this purpose to request a spare frequency. He should promptly report the incident in accordance with the format below. This report must be made regardless of whether or not the radio operator is successful in working through the interference.

Prompt, accurate, and complete reporting is imperative to evaluate and correct interference incidents. All incidents must be reported via secure means to the Net Control Station ASAP, that means within ten (10) minutes of the incident. The NCS will deliver the report to the C-E officer, who will prepare the MIJI report shown at Appendix I and forward it through channels to the EW center. Concurrently, the C-E officer will coordinate with the local EW officer, intelligence officer, and the supporting ASA element to solve the problem. All interference reports will be marked with the appropriate classification.

Transmission by electrical means is authorized; however, transmission must be secured by an on-line or off-line system. The interference report will contain the following information and will be prepared using the brevity list provided below. For security, these brevity list numbers must be encrypted in the numeral cipher or authentication system prior to transmission. If it cannot be transmitted, the information must be provided to the C-E officer by the fastest alternate means available.

Reports will contain the following information:

LINE 1 - Type of Report

1. Meaconing
2. Intrusion
3. Jamming
4. Interference

LINE 2 - Affected Station

Give the NCS the last letter of your call sign and your suffix.
NOTE: This line need not be encrypted.

LINE 3 - Station's location or grid coordinates

NOTE: Grid zone letters may be included in messages, but only when they are necessary to clarify the location. If it is necessary to include them, you must note the fact, or they may be confused with the encrypted coordinates.

LINE 4 - Frequency or channel affected

Encrypt the frequency (in MHz) or the channel on which you experience interference.

LINE 5 - Type of equipment affected

5. AM/SSB/RATT
6. FM radio
7. Radar
8. NAVAID

LINE 6 - Type emission or audio characteristics of interference

9. Random keyed CW/RATT
0. Keyed CW
1. Stepped tones (bagpipes)
2. Modulated tone
3. Random noise/static
4. Gulls
5. Pulse
6. Wobbler
7. Unidentified voice, chatter, traffic, or music
8. Friendly call sign, chatter, or traffic

LINE 7 - Strength of interference

9. Weak
0. Medium
1. Strong

LINE 8 - Time interference started

LINE 9 - Interference effectiveness

Using the scale 00-100, encrypt the estimated percentage of copy lost or the percentage of time radar/NAVAID was ineffective.

LINE 10 - Operator's name and rank

LINE 11 - Remarks

Include any amplifying data that might help to evaluate the interference; e.g., type of mission, weather conditions, use or purpose of frequency affected, aircraft flight plan, duration of interference, etc. This portion may be a narrative explaining exactly what did happen.

NOTE: Lines 10 and 11 will be omitted when report is transmitted electrically; however, a followup report should be forwarded to the C-E officer providing amplifying information on the incident within 24 hours of the encrypted report.

Appendix I — Meaconing, Intrusion, Jamming, Interference (MIJI) Report (For the C-E Officer)

(Completed by C-E officer and forwarded through channels to EW center.)

General Instructions

1. Report by electrical message within 24 hours of the incident.
2. Use ROUTINE precedence unless otherwise directed in local regulations.
3. Classify report at least UNCLAS EFTO to insure transmission by encrypted means only.
4. Commanders may abbreviate local formats to include only appropriate items. However, always report applicable portions of items 1 through 10 and item 39. Report items 11 through 38, as appropriate.
5. Use item numbers for identification, but item titles need not be included.
6. Expand answers for individual items as necessary.

NOTE: If it's determined by the command that the interference was clearly unintentional and beyond resolution with the command, the Area Frequency Coordinator will initiate a harmful interference report, in the MIJI report format in accordance with the policies and procedures established by ACP 190 and USS SUPP-1, title: Frequency Management, and ACP 121 and US SUPP-1, title: Communications Instructions General. Information addressees will include the Air Force Electronic Warfare Center (AFEWC), Kelly AFB, Texas, and US Army Communications Command (USACC), ATTN: SCC-FD-C, Fort Huachuca, Arizona.

ELECTRICAL TRANSMISSION FORMAT

PRECEDENCE:

FROM:

TO: AFEWC, KellyAFB, Texas (Other addressees as appropriate)

INFO: (Parent organization, other)

CLASSIFICATION: (At least UNCLAS E F T O)

SUBJECT: MIJI Report (U), RCS: JCS-1066(MIN)

1. Receiving station experiencing MIJI—

Aircraft Report:

a. Type, tail number, call sign.
b. Type mission (strike, recon, training) and nicknames, if any.
c. Departure and destination.
d. True course, ground speed, and mean sea level altitude.
e. Parent organization.

Ground Site Report:

g. Victim designation and call sign.
h. Victim function (Surveillance, GCI, Communications, etc.).
i. Parent organization (when applicable).

Ship Report:

s. Type, call sign, number, and name.
t. Route or operations area.
u. True course and speed.
v. Type mission (training, patrol, etc.).

2. Type incident. Meaconing, interference, jamming, or intrusion.
3. Operator's name and function.
4. Weather conditions.
5. Nomenclature of equipment affected.
6. Were scope photos/drawings or signal recording made? If so, indicate to whom sent. (If available, photos/drawings or recordings should be forwarded to AFEWC, Kelly AFB, TX 78243).

NOTE: On Photos/drawings include azimuth, heading, range mark values, and other orientation data, and identification/nomenclature of scope used to obtain photos/drawings. On tapes indicate recording speed and approximate location of MIJI signal; annotate with operator's comments if possible.

7. Date/Time (Z)/Coordinates MIJI began.
8. Date/Time (Z)/Coordinates MIJI most effective.
9. Date/Time (Z)/Coordinates MIJI ended.
10. List any bearing(s) to MIJI source with corresponding time (Z) and victim coordinates.

COMMUNICATIONS

11. Transmitter being affected.
    a. Call sign.
    b. Frequency.
    c. Type modulation.
    d. Bandwidth.
12. MIJI (Interfering signal)
    a. Call sign.
    b. Frequency (add "M" if measured).
    c. Measured (M) or estimated (E) bandwidth.
    d. Type emission or audio characteristics.
13. Use or purpose of frequency affected.
14. Other stations/units heard on frequency.
15. MIJI effectiveness (percent of copy lost).
16. Other stations/units confirming MIJI.
17. How did MIJI end? (Faded, ended, abruptly, victim/MIJI shifted frequency).
18. ECCM used and results. (Alternate frequencies used successfully.)

NAVAIDS

19. Identification and location of NAVAID affected.
20. Type of NAVAID, frequency, and/or channel.
21. MIJI call sign heard.
22. MIJI effects/characteristics.
23. Other NAVAIDS being monitored.

RADAR

24. Victim operating frequency.
25. MIJI signal bandwidth.
26. Sector width of main lobe jamming and azimuth of strongest intensity. (Use optimum gain.)
27. Sector width of side or back lobe jamming and azimuth of strongest intensity. Report whether back or side lobe.
28. Type MIJI (CW/Pulse/Noise/etc.).
29. MIJI effectiveness (percent degradation of target detection capability inside and outside the sector affected by MIJI).
30. Persistence of MIJI. (Steady/varied/off-on; explain)
31. Was MIJI present in:
    a. Standby mode?
    b. Sector scan?
    c. With antenna stopped?
    d. After changing range modes?
32. Antenna tilt or elevation for maximum interference.
33. ECCM used and results.
34. Best ECCM mode.
35. If ESM receivers available, results of frequency spectrum check. Attempt to associate MIJI signal with other activity (that is, check by sync (PRF, Scan) with other signals on MIJI line of bearing).

RHAW AND CHAFF

36. MIJI effect on RHAW:
    a. Billboards illuminated?
    b. Strobe (type, length)?
    c. Audio?
37. CHAFF:
    a. Track length, width, and altitude?
    b. Coordinates for start, stop, and turn points?
    c. Estimated rate of fall?
    d. Chaff and aircraft fade time?
    e. Type of drop (random, stream, etc.)?
    f. Wind direction and velocity?
    g. Were chaff samples obtained? If so, indicate to whom sent.

ELECTRO-OPTICS

38. Electro-Optics (E-O)
    a. Frequency or wavelength affected.
    b. Type of equipment/ordnance affected.
    c. Effect on equipment/ordnance (scope blanked, weapon diverted from target, etc.).
    d. Overall E-O MIJI effectiveness.
    e. Concurrent visual/audio indications of possible E-O MIJI.

NARRATIVE

39. a. Summarize briefly the MIJI incident. Operator explanation of just what happened.

b. List ships, ground units, aircraft in vicinity which might be MIJI source. (Use only secure communications to discuss MIJI with other units.)

c. State mission phase at the time of incident (routine operations, in combat, flying to target, etc.).

d. Include the term "final report" if no additional reporting is anticipated.

Appendix J — Precedence System

The precedence system is directed for use by users of the voice communications facilities of DOD. All users must be familiar with the purpose to be served by each precedence category and the type of calls which may be assigned the respective precedences. Users must also exercise care not to request or utilize a higher precedence than the circumstances require.

Order of Precedence:

(1) FLASH OVERRIDE will preempt FLASH calls in progress. It is authorized for use by the President of the United States, Secretary of Defense and Joint Chiefs of Staff. Commanders of Unified and Specified Commands, and the CINCNORAD may also use it when declaring either Defense Condition one, Defense Emergency or Air Defense Emergency respectively.

(2) FLASH preempts calls of lower precedence. Flash precedence is generally reserved for calls pertaining to: command and control of military forces essential to defense and retaliation; critical intelligence essential to national survival; conduct of diplomatic negotiation of critical civil alert information essential to national survival; fulfillment of critical United States internal security functions essential to national survival; and catastrophic events of national or international significance.

(3) IMMEDIATE preempts calls of lower precedence. Immediate precedence is reserved for vital communications which: Have an immediate effect on tactical operations; directly concern safety or rescue operations; or affect the intelligence community operational role. (Examples of situations requiring this precedence: Initial vital reports of damage due to enemy action; land, sea or air reports which must be completed from vehicles in motion; intelligence reports on vital actions in progress; natural disaster or widespread damage; emergency weather reports having an immediate bearing on missions in progress; emergency use for circuit restoration; and use by tactical command posts for passing immediate operational traffic.)

(4) PRIORITY preempts routine telephone calls. Priority precedence is reserved for calls which require prompt completion for national defense and security, the successful conduct of war, or safeguarding life or property, but do not require higher precedence. (Examples of situations requiring this precedence: Reports of priority land, sea or air movements; administrative, intelligence, operational or logistic activity calls requiring priority action; calls that would have a serious impact on military activities if handled as a ROUTINE call.)

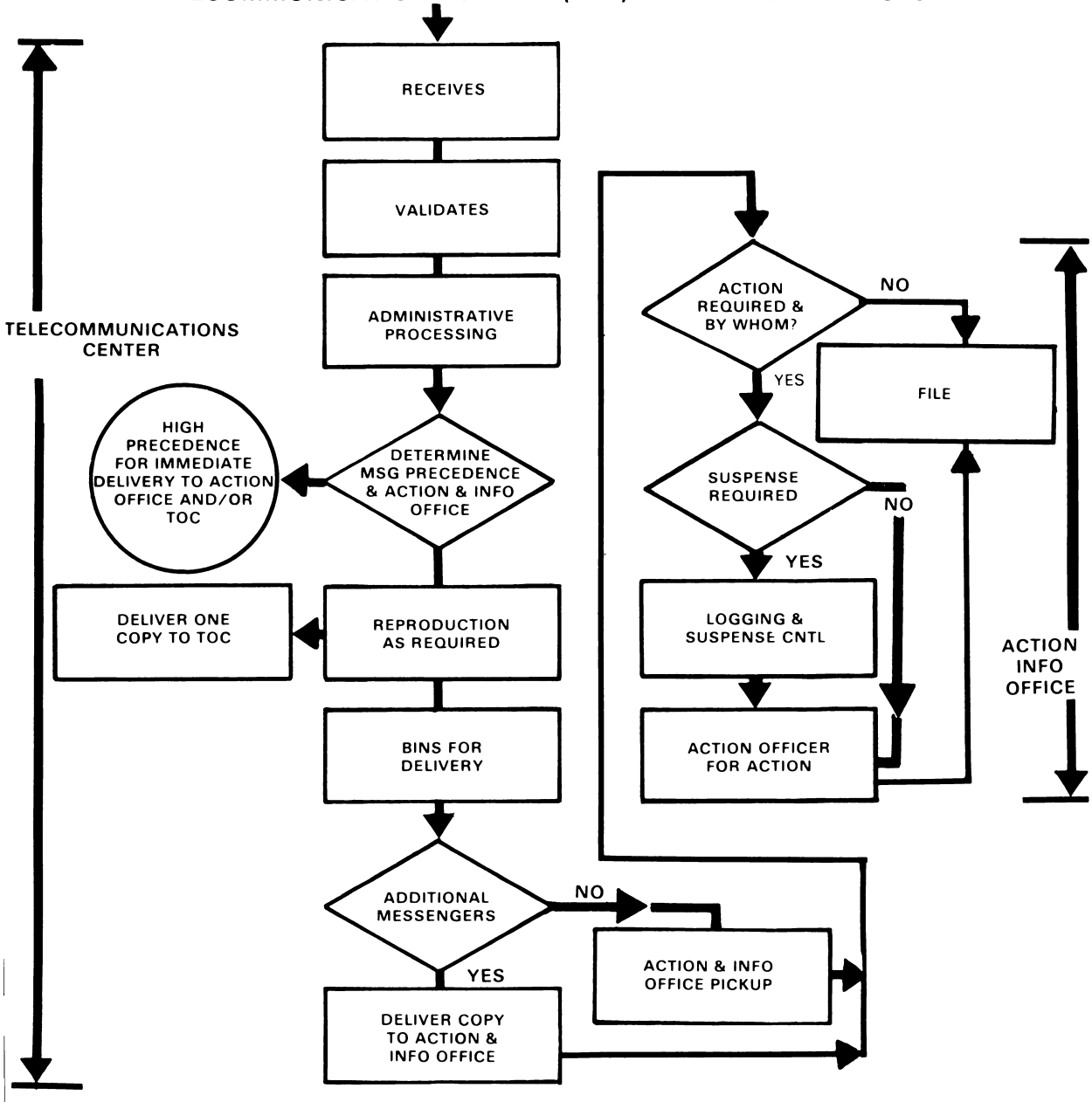
(5) ROUTINE has no precedence over any other call. All official communications to which preceding precedences do not apply will be routine.

Appendix K — Telecommunications Center Functions

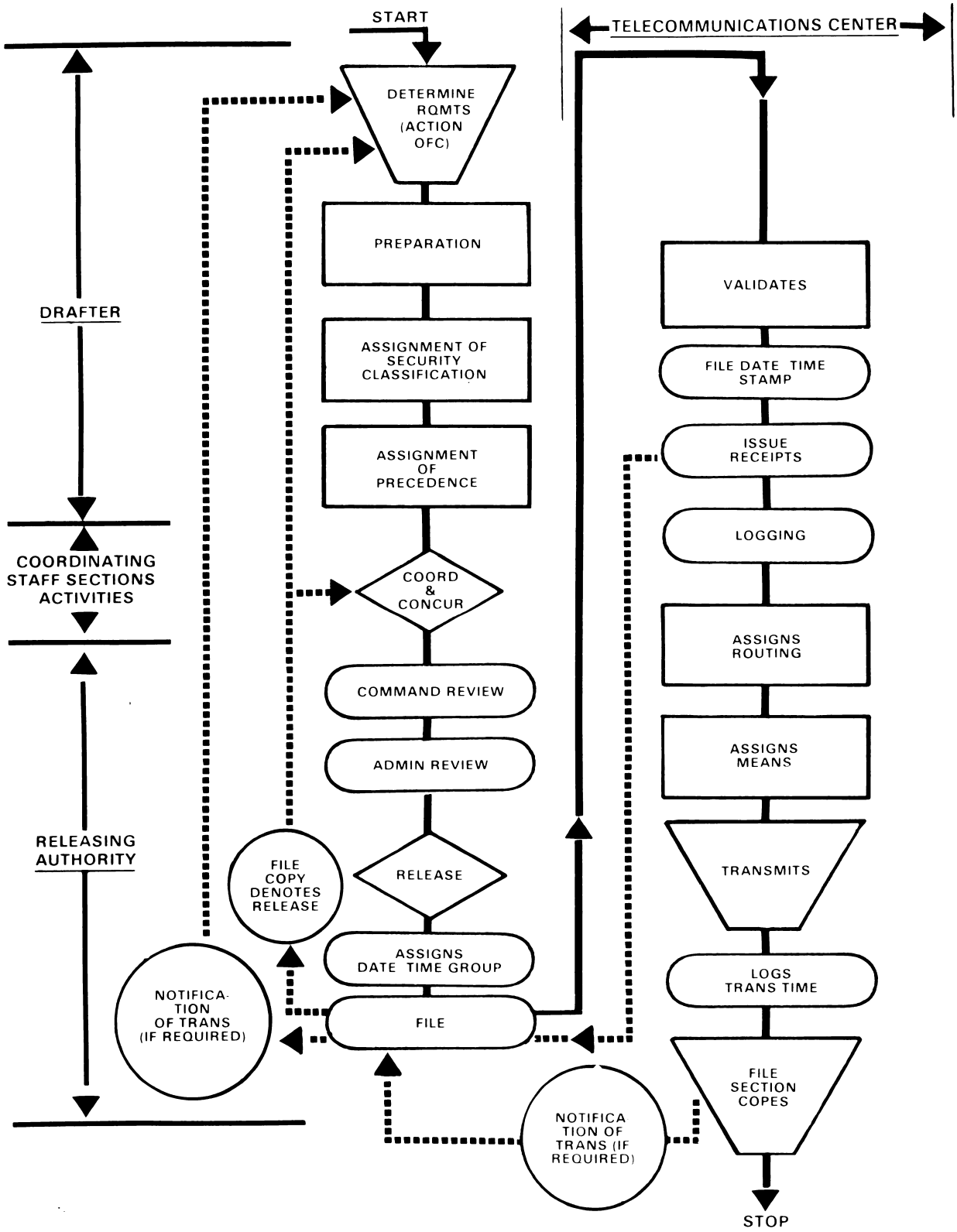
The concept of the integration of communications center and staff message center functions has been approved for implementation in TDA and TOE units. The functions of message processing to include delivery are the responsibility of the C-E officer. Those units with habitually low precedence traffic of routine nature or those units having a TOE which will not permit personnel tradeoffs from the staff message center may provide over-the-counter service to all action and information offices, except when the action office is the Tactical Operations Center (TOC).

The charts below and on the next page give a sample of a TCC's incoming and outgoing message handling functions under the integrated concept.

TELECOMMUNICATIONS CENTER (TCC) INCOMING MESSAGES



TELECOMMUNICATIONS CENTER (TCC) OUTGOING MESSAGES



Appendix L — C-E System Closeout Procedures

PURPOSE:

TO INSURE THAT:(1) ALL COMMUNICATIONS CUSTOMERS KNOW THAT SERVICE IS TERMINATING AND WHEN IT IS TERMINATING, (2) EACH C-E OPERATOR KNOWS WHERE TO GO AND WHAT TO DO NEXT, AND (3) THE STATUS OF CIRCUITS, SYSTEMS AND NETS ARE RECORDED FOR THE COMMANDER'S INFORMATION AND FUTURE PLANNING.

SENIOR C-E OFFICER

- RECEIVES ORDERS TO RELOCATE OR TERMINATE COMPLETELY.
- PASSES ORDER TO

C-E UNIT COMMANDERS

COMMUNICATIONS SYSTEM CONTROL ELEMENT (CSCE)

- RECORD ORDER IN COMMUNICATIONS CONTROL JOURNAL
- PREPARE CLOSE-OUT ORDER FOR CNCE
  - — VERBAL
  - — TELETYPE
  - — USE DRYAD CODE OR CEOI CODES FOR LOCATIONS, ETC., AND AUTHENTICATION.
- TRANSMIT ORDER
  - — INTERCOM TO LOCAL CNCE'S
  - — SOLE-USER CIRCUITS TO OTHER CNCE'S

COMMUNICATIONS NODAL CONTROL ELEMENT (CNCE)

- LOG INFORMATION IN COMMUNICATIONS CONTROL JOURNAL.
- DIRECT ITS TERMINAL FACILITIES (SWBD, RWI, TCC, RADIO NCS, PATCH PANEL,CABLE TEAMS, ETC.) TO NOTIFY EACH OF THEIR SUBSCRIBERS AND "STRAP-THRU's" TO TERMINATE THE CIRCUITS/NETS BY THE DESIGNATED TIME.
- RECORD THE CIRCUIT/NET CLOSING TIMES REPORT BY THE TERMINALS.
- REPORT TO THE CSCE THAT THE CIRCUITS/NETS HAVE BEEN CLOSED OUT.

CSCE

- POST EACH CIRCUIT/NET CLOSE-OUT ON STATUS BOARD AND RECORD CARDS.
- CONTROL ENTIRE SYSTEM CLOSE-OUT BY:
  - — ISSUING CLOSE-OUT ORDER AND FUTURE OPERATIONS INSTRUCTIONS TO CNCE FOR DESIGNATED MULTICHANNEL SYSTEMS.
  - — NOTIFY MOST DISTANT CNCE IN SYSTEM FIRST, THEN WORK BACK THRU CNCE's AS REQUIRED.
  - — POSTING CLOSING TIMES TO JOURNAL AND RECORD CARDS, AND UPDATE STATUS BOARD.

MOST DISTANT CNCE

- POST ORDER TO CLOSE DESIGNATED SYSTEM.
- DIRECT CONTROLLING MULTICHANNEL TERMINALS AND CABLE TEAMS TO CLOSE OUT THEIR SYSTEMS.
- ISSUE INSTRUCTION ON WHAT TO DO AND WHERE TO GO AFTER CLOSING OUT THEIR SYSTEMS.
- RECORD SYSTEM CLOSING TIMES WHEN REPORTED BY TERMINAL.
- REPORT SYSTEM CLOSING TIME TO CSCE.

CONTROLLING MULTICHANNEL OPERATOR

- ALERT DISTANT TERMINAL, AND EACH RELAY IN BETWEEN VIA ORDERWIRE.
- RELAY FUTURE OPERATIONS AND CLOSING INSTRUCTIONS TO EACH TEAM IN SYSTEM.
- USE DRYAD CODE OR CEOI INSTRUCTIONS WHEN MAKING REFERENCE TO UNITS, LOCATIONS, MISSION, FREQUENCIES, ETC.
- CONTROL ACTUAL CLOSE-OUT BY:
  - — HAVING ALL TEAMS ON THE ORDERWIRE INITIALLY.
  - — ORDER DISTANT TERMINAL TO CLOSE, FOLLOWED BY EACH RELAY IN-TURN.
- RECORD SYSTEM CLOSING TIME ON LOG.
- REPORT SYSTEM CLOSING TIME TO CNCE.
- MAKE FINAL PREPARATIONS TO MOVE.
- MAINTAIN CONTACT WITH CONTROLLING UNIT THRU FM RADIO AND MESSENGERS DURING BREAKDOWN AND MOVE.

Appendix L — C-E System Closeout Procedures

Appendix M — Field Expedient Antennas

This appendix discusses the basic types of tactical antennas, and gives some field expedient solutions to their being broken or damaged. These solutions are only temporary, but they will help you get the message through.

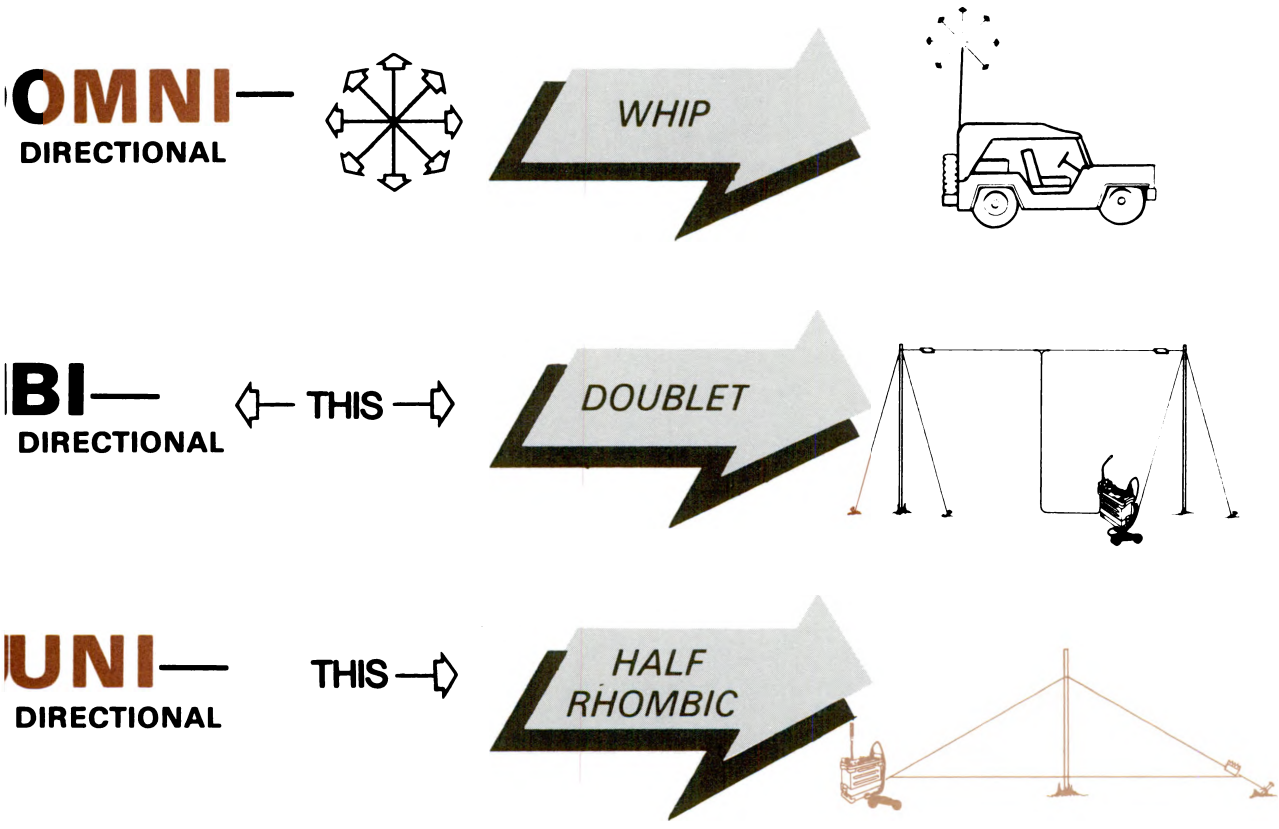
Field expedient antennas sometimes provide a way to beat the enemy's Electronic Warfare efforts. A field expedient bi- or uni-directional antenna can be used to prevent the enemy from intercepting transmissions. If you use a whip antenna, you can expect the enemy to intercept and locate your transmitter 73% of the time. If you use a horizontal/directional antenna, you can eliminate his ability to locate you and reduce his probability of intercept to only 8% of the time. (These figures apply to the PRC-77 radio, however, the same basic facts apply to all radios.)

When you fabricate an antenna, there is one important fact that you have to keep in mind--the location of the station(s) you need to communicate with. Why? Because the direction and distance are critical factors and the selection of the right type of antenna is important. Basically, there are three types of antennas according to their directional characteristics. They are--

OMNI-Directional ..... **All directions**

BI-Directional ..... **Any two opposite directions**

UNI-Directional ..... **Any one direction**



OMNI-DIRECTIONAL ANTENNAS

The vertical whip antenna is the most widely used omni-directional antenna found in the military. The tactical communicator is most familiar with the whip antenna used on vehicles, and the ground plane antenna which is usually mounted on masts or other structures.

The vertical whip is omni (all)-directional, and its efficiency is related to the transmitting frequency and antenna height. At lower frequencies its efficiency is very low, but as the frequency is increased, its efficiency also increases. The problem with height can be helped by placing the antenna on top of a hill or by fastening it to a pole or tree to increase its height above surrounding structures.

If your whip antenna is damaged or missing, here are some quick solutions to your problem.

Whip Antennas

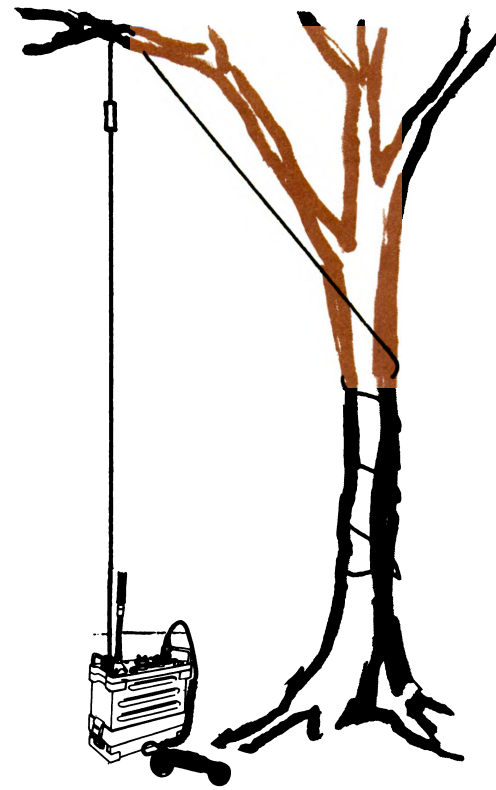
Here's how to put up some quarter-wave vertical antennas. These are used to replace regular whip antennas.

Step 1. Using the quick reference chart at the end of this appendix or the formula for a quarter wave, cut a wire to the required length.

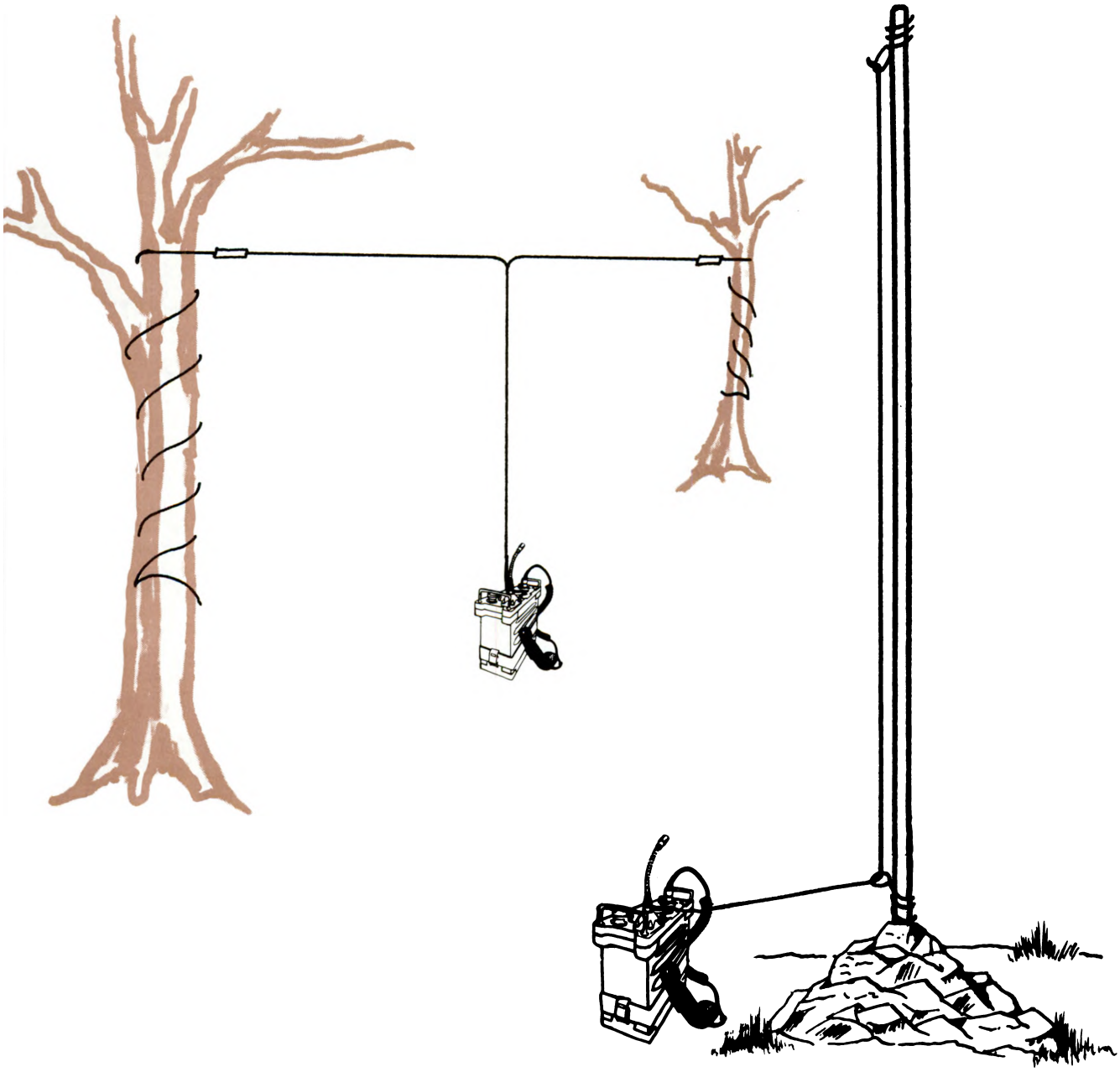
Step 2. Attach an insulator to one end and attach the other end to the antenna connector on your radio.

Step 3. Tie a rope to the insulator end and throw the rope over a limb.

Step 4. Pull it up till it's vertical and it's ready to go. Don't forget to ground your radio.



M-2



The verticals shown here are constructed the same way, but each has a different means of support. They are all simple and quick to fabricate.

If you're using insulated wire, be sure to loop the wire around the handle of the radio before attaching it to the antenna connector. If your antenna is made of bare wire, use a stake and insulator to keep the antenna wire from pulling out of the antenna connector on the radio.

RC-292

The RC-292 is a highly effective, omni-directional antenna. It is usually much more effective than a whip antenna, and is particularily effective in the VHF frequency range.

When this antenna is damaged or not available, there are several field expedient versions that can easily be fabricated.

Three ways of replacing an RC-292 antenna for emergency operation.

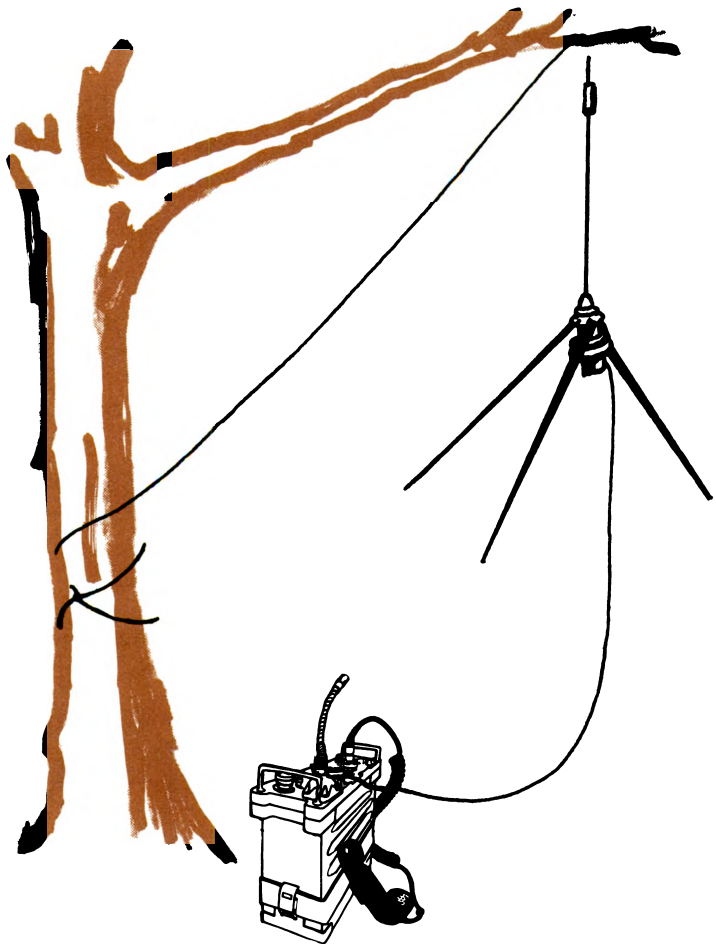
The first method is useful in heavily wooded areas where tree limbs can be used to raise the antenna.

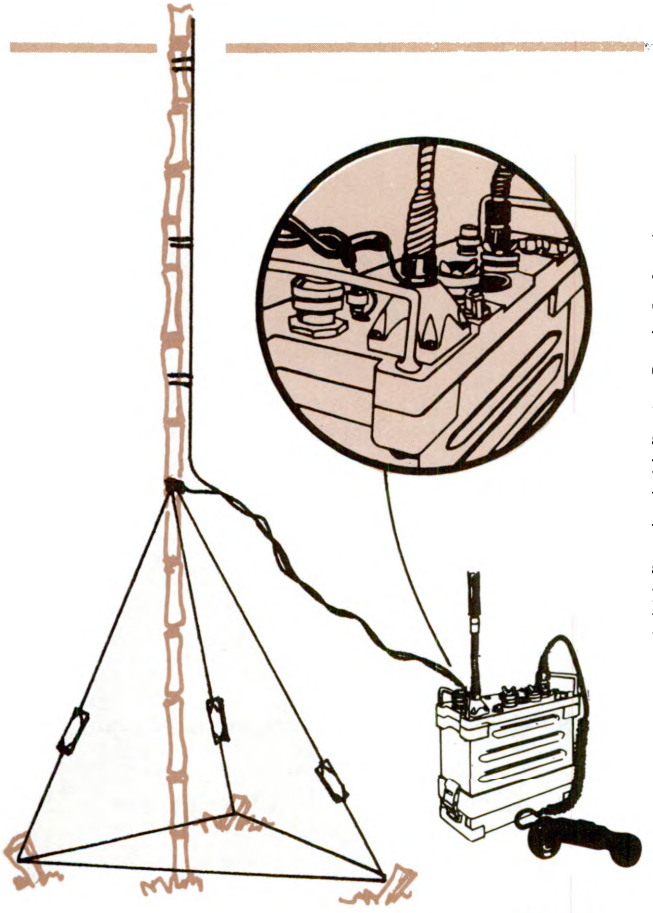
Step 1. Using the quick reference chart at the end of this appendix (or the formula, if you have it), cut all four wires for a quarter wave antenna. Connect them as shown.

Step 2. You'll need two insulators; one at each end to separate the vertical elements. You can attach a rope with a rock tied to it to throw the rope over a tree limb.

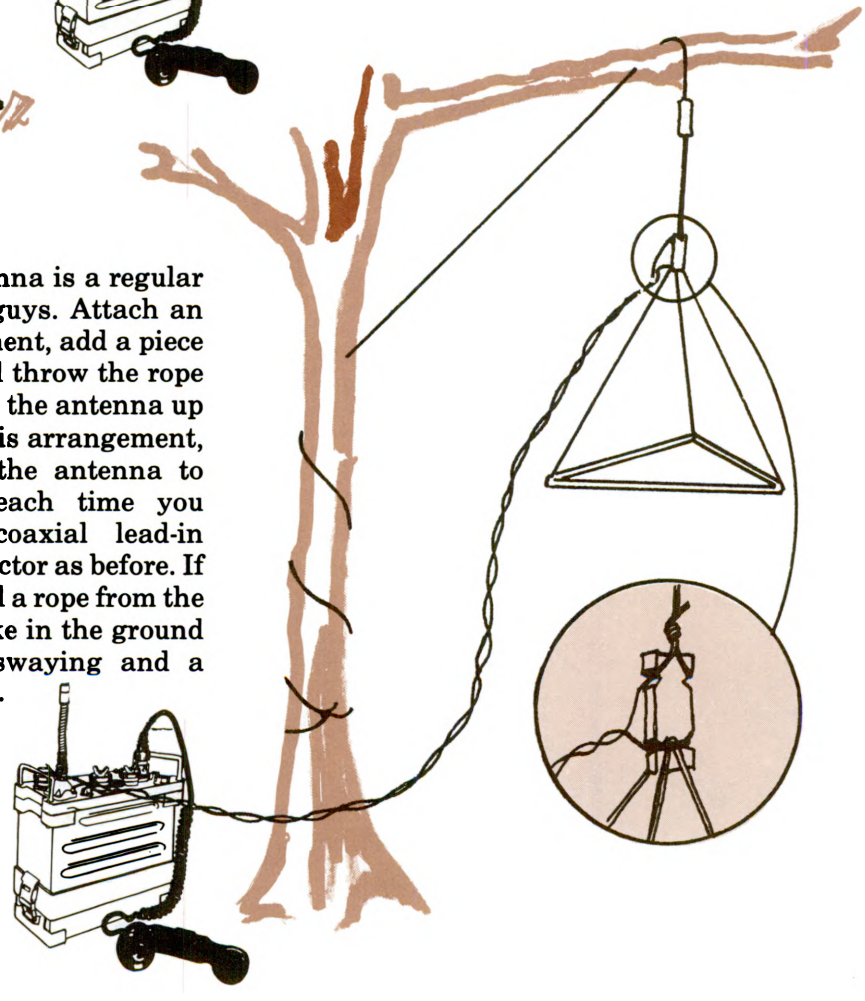
Step 3. Connect the WD-1 as shown, before you pull the antenna up in the air.

Step 4. At the radio, connect one wire of the WD-1 to the antenna connector and one wire to the radio chassis.





Here is a ground plane antenna for areas with no trees or mast substitutes. Compute and cut the four wires for a quarter wave. You can use a single pole in the middle to support the whole thing. The ground plane elements double as the guy wires. Use insulators to separate the ground plane elements from ground. The vertical element must also be insulated from the ground planes. Connect the vertical element to the output terminal of the radio and the ground planes to the radio ground. This antenna will work, but not nearly as well as one that is above ground level.



This ground plane antenna is a regular RC-292 without a mast or guys. Attach an insulator to the vertical element, add a piece of rope, tie on a weight, and throw the rope over a handy tree limb. Pull the antenna up as high as possible. With this arrangement, you can raise and lower the antenna to change element lengths each time you change frequency. The coaxial lead-in attaches to your radio connector as before. If you expect strong winds, add a rope from the bottom of the head to a stake in the ground below. This will prevent swaying and a signal that fades in and out.

BI-DIRECTIONAL ANTENNAS

The typical military half-wave antenna is a highly effective bi-directional antenna. It is normally used in the high frequency range.

HF Doublet

When a doublet isn't available, you can easily fabricate a replacement which will do a very good job. The antenna we'll show can replace your doublet when necessary. You'll need these items:

-Two supports, 19-to 30-feet high.
-Wire, any type that's long enough.
-Rope or wire for halyards.
-Three insulators.
-A water can or similar heavy object.

Now build it!

Step 1. Cut the wire to your operating frequency using the chart or formula to compute the length needed for a half-wave antenna.

Step 2. Determine your direction of transmission, because the doublet antenna is BI-Directional and shoots straight out from both sides of the wire.

Step 3. Cut the wire in half and put an insulator on each wire end.

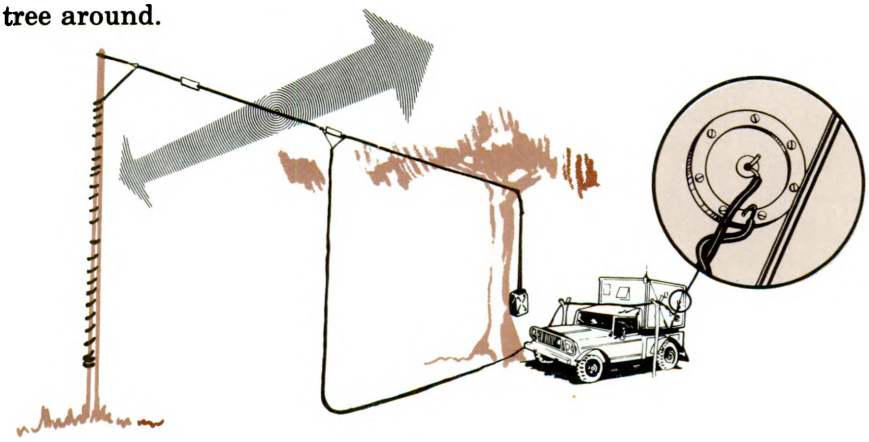
Step 4. Locate and erect the two supports. Be certain they are 3 or 4 feet further apart than the antenna's actual length, and broadside to the direction of communication.

Step 5. Separate the two wires of the WD-1 far enough to attach one wire to each end of the center insulator. Be sure it is long enough to drop nearly to the ground and then to your radio's position.

Step 6. Tie rope or wire to the two end insulators, then using whatever method is easiest, hang the antenna up between the supports, keeping it as level as possible.

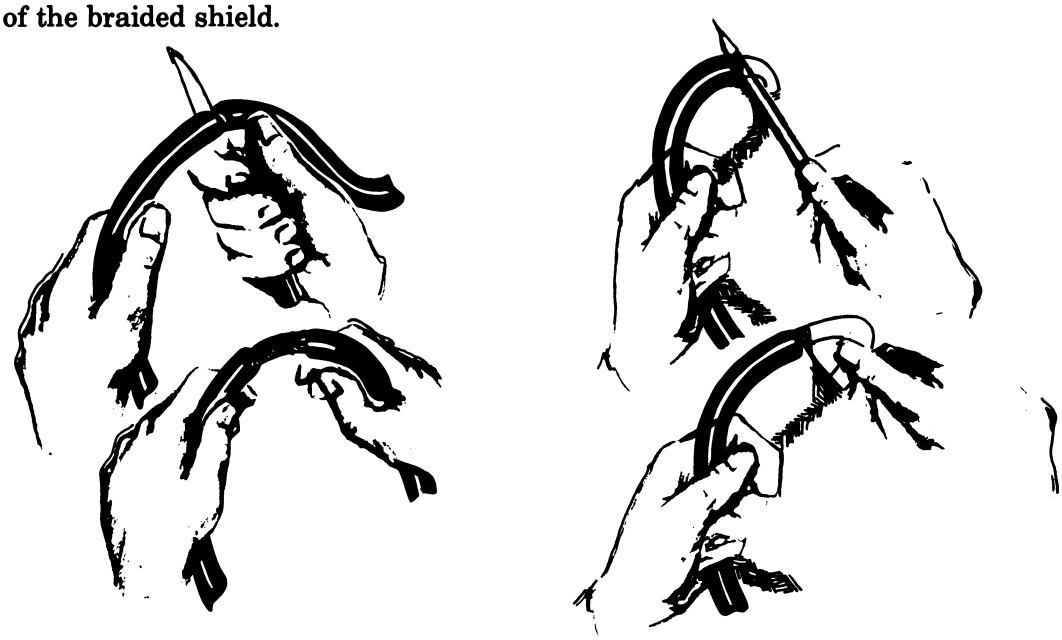
Step 7. Connect one wire of the WD-1 to the antenna connector of the radio set and the other wire of the WD-1 to a ground point on the radio. The ground point should be as close as possible to the antenna connector.

In this example, we've used a can tied to one end to demonstrate counterweight. This is tied to the tree end halyard, and prevents the antenna from breaking in case of high winds blowing the support tree around.

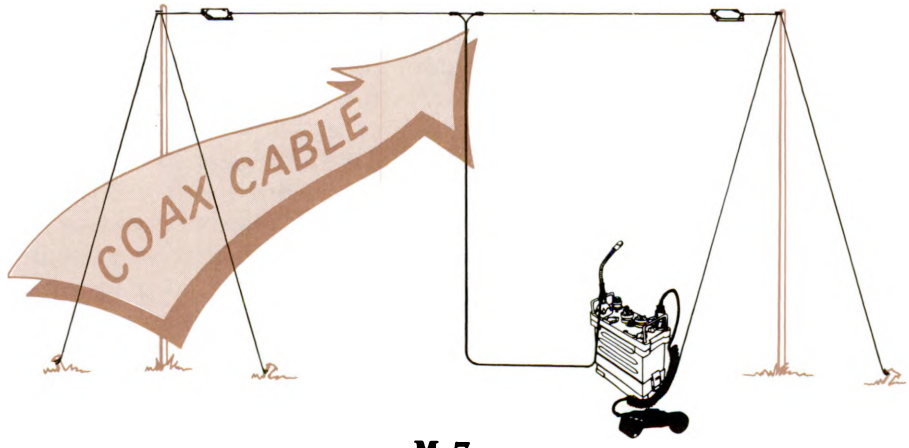


Coaxial Antenna

So you've got to replace your doublet and don't have any wire, just a long piece of coax cable. Figure the length of antenna you need using the formula or the quick reference chart. Let's say you need a 14′ antenna; just measure off 7′ of coax and mark the spot. Using a knife or sharp object, carefully cut through the rubber outer insulation, don't cut into the braid shield. After you cut it evenly all the way around, you'll be able to pull off the insulation leaving the braid shield exposed. Bend the coax in a loop and hold it in one hand. Using a nail or pencil carefully separate the braided shield from the insulated center conductor. Now gradually work the pencil in between the coax and the center conductor as shown. Keep the loop formed and stick a finger in the hole you've made with the pencil. Slowly pull on the center conductor and you'll be able to pull it out of the braided shield.

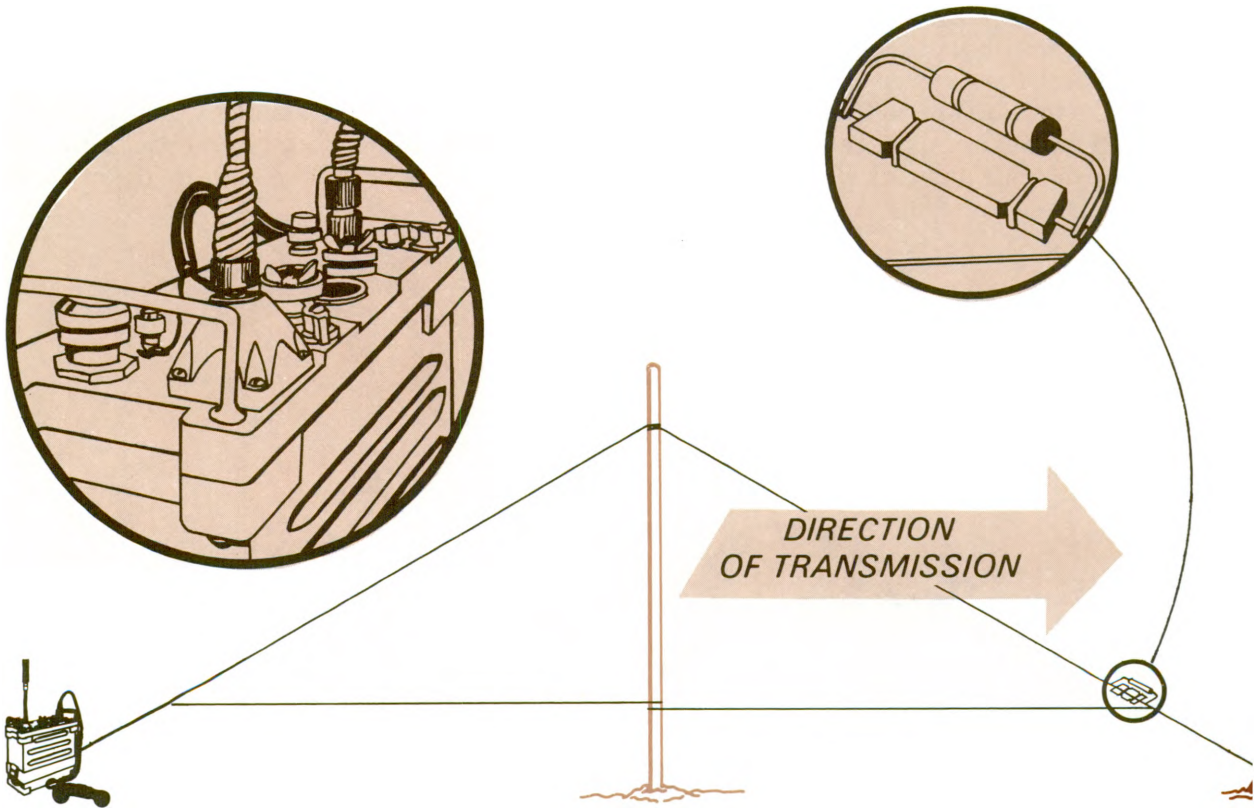


In this illustration, you see a coaxial antenna consisting of 7 feet of braided shield and 7 feet of insulated center conductor. Both are firmly attached to the remainder of the coax which is your lead-in cable. All you need to do now is tie an insulator on each end, attach ropes, find something to use as supports and put it up as flat as possible across the top. Now you have a good 14-foot doublet antenna.



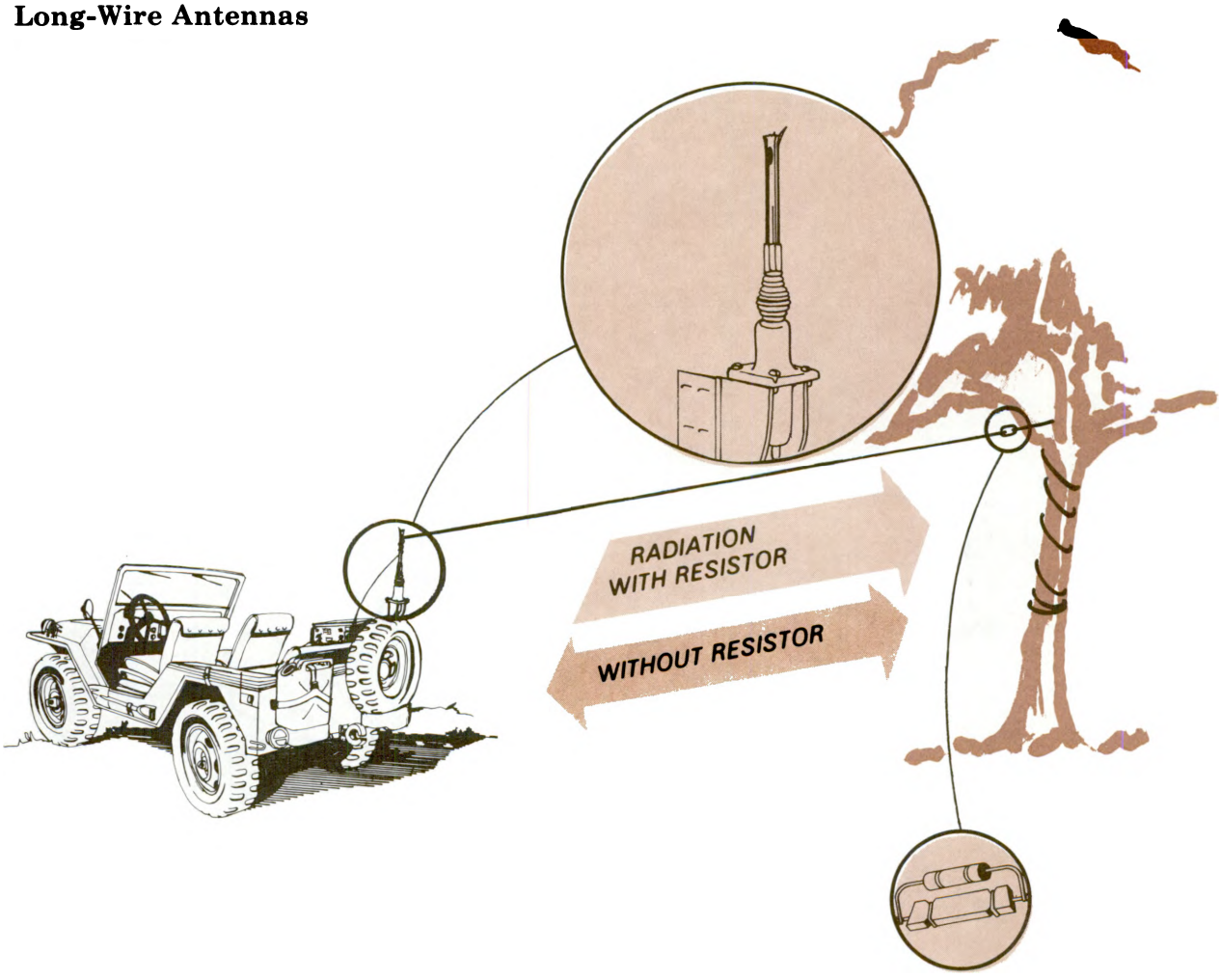
UNI-DIRECTIONAL ANTENNAS

Vertical Half Rhombic



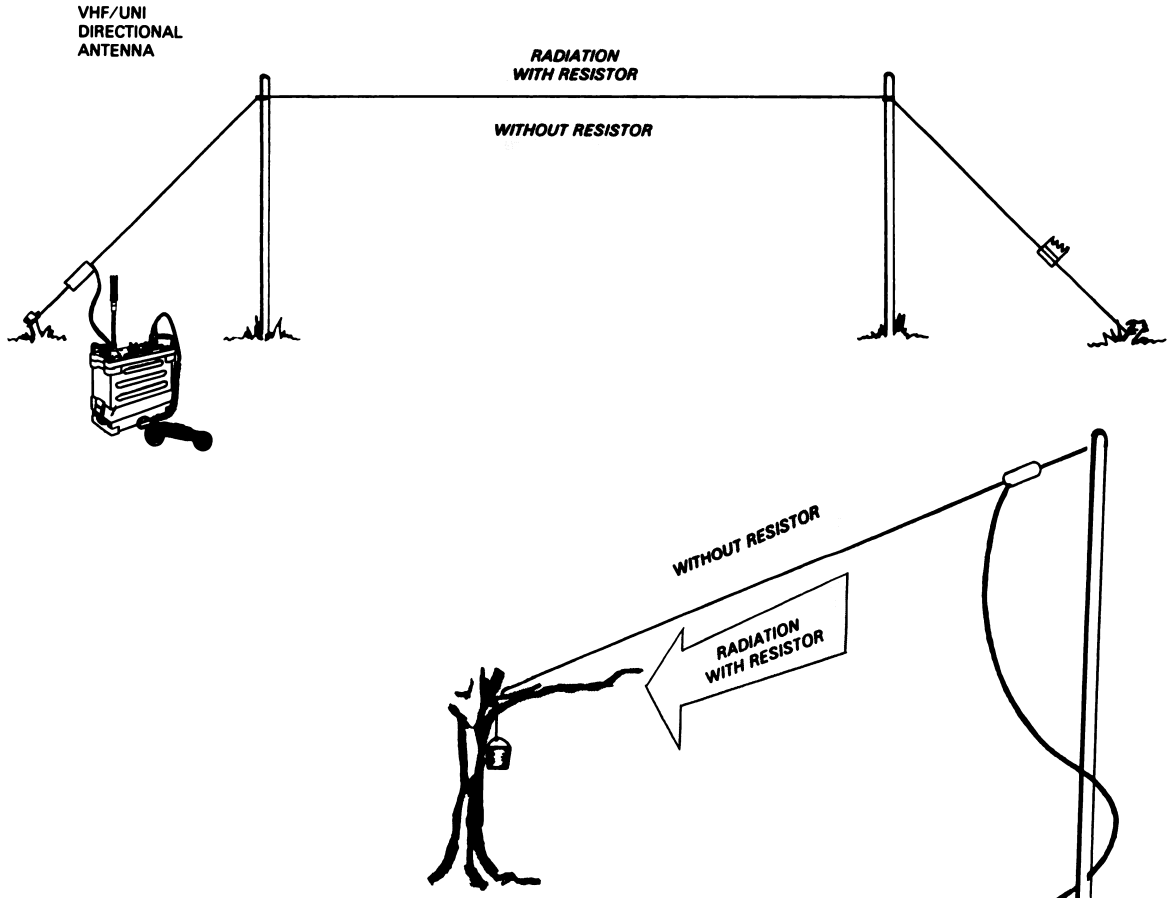
You say this antenna looks like the end of a big pup tent? Good! That means it's put up correctly. Use it to work out of a bad spot when your manpack's whip won't do the job. Tie insulators on both ends of 100 feet of any kind of wire. Run one end in the direction of the people you have to talk to, tie some wire to the other side of that insulator and stake it down with a metal stake. You need to support the center of the wire with a mast tree, pole or whatever's handy that is 20-30 feet high. Keeping the direction line straight, extend the near end till it's tight, attach more wire to the other side of the insulator and stake it down, again using a metal stake. Attach WD-1 lead-in wire as shown, and you're on the air. Here are a couple of tricks if you have the materiel and time.....Run a length of WD-1 from the ground side of both insulators, stretched so it's right under the antenna and about a foot high, then attach another piece from the near end ground stake to a screw on your radio set case. Why? Because it'll improve your signal. It's called a counterpoise. When you wire a 600-ohm, 1- or 2-watt carbon resistor across the insulator at the far end, you really improve your radio's punch in that direction. It's BI-Directional without the resistor and UNI-Directional with it.

Long-Wire Antennas



This long wire is a quick fix for a broken vehicle antenna. Pick a support at least 15-feet high, in the direction you have to communicate. Move your vehicle so the support is on a line with the station you need to reach and 100 feet from you. Run a piece of WD-1 to the tree or pole you have selected as a support. Attach an insulator to a rope or wire and tie it to the support. Connect the 100-foot WD-1 to the insulator. Pull the slack out of the antenna. Wrap the WD-1 around the lower part of the broken whip and connect it to the ANT (connector) on the radio. Make sure you remove the control cable and antenna cable connected between the matching unit and radio. Now you're ready to operate. Remember to point your antenna in the right direction, and keep in mind that you should not tie the antenna close to the tree's foliage. By following the above steps, you have converted the original omni-directional antenna into a bi-directional antenna. If you add a 600-ohm carbon resistor to the end of the wire by the tree, you will convert the antenna to a UNI-Directional antenna. The wattage rating of the resistor MUST be at least half the output rating of the transmitter.

Here's another way of erecting a long wire antenna. Its overall length must be 3-7 wavelengths. Use the chart or formula to get the correct wire length. It's UNI-Directional with the 600 ohm resistor and BI-Directional without the resistor. The wattage rating of the resistor must be at least half the power output of the transmitter. You'll need to put some side guys on the 9-10′ lance poles to hold them up. The antenna is erected as shown, use insulators wire, stakes etc, same as the others. You'll be able to communicate with increased range.



This 100-foot long wire antenna will work when you are operating in the 30-80 MHz frequency range. For HF operation, the antenna wire must be longer. This type of antenna will improve the range of your radio in both directions (BI-Directional) extending from the ends of the wire, if it's used without a resistor. If a resistor is used the antenna becomes UNI-Directional.

HOW TO DO IT.....WITH FORMULAS

■ To figure a quarter wave length in feet: Divide 234 (constant) by your operating frequency in MHz. Example: 234 ÷ 44.8 = 5.22′ or 5′3″.

■ To figure a half wave length in feet: Divide 468 (constant) by your operating frequency in MHz. Example 468 ÷ 56 = 8.36′ or 8′5″.

■ To figure a full wave length in feet: Divide 936 (constant) by your operating frequency in MHz. Example: 936 ÷ 45 = 20.8′ or 20′10″.

■ To convert feet to meters, multiply by .3048 (constant). Example: 110′ x .3048 = 33.5 meters.

■ To convert meters to feet multiply by 3.28 (constant). Example: 100 (meters) x 3.28 = 328 feet.

QUICK REFERENCE CHART

High Frequency (HF) Antenna Length in Feet & Inches				Very High Frequency (VHF) Antenna Length in Feet & Inches			
Op Freq in MHZ	1/4 Wave	1/2 Wave	1 Wave	Op Freq in MHZ	1/4 Wave	1/2 Wave	1 Wave
2	117′	234′	468′	30	7′10″	15′7″	31′2″
3	78′	156′	312′	33	7′1″	14′2″	28′4″
4	58′6″	117′	234′	35	6′9″	13′5″	26′10″
5	46′9″	93′7″	187′4″	37	6′4″	12′7″	25′2″
6	39′	78′	156′	40	5′10″	11′8″	23′4″
7	33′5″	66′10″	133′8″	43	5′5″	10′10″	21′8″
8	29′3″	58′6″	117′	45	5′3″	10′5″	20′10″
9	26′	52′	104′	48	4′10″	9′8″	19′4″
10	23′5″	46′10″	93′8″	50	4′9″	9′5″	18′10″
11	21′3″	42′6″	85′	55	4′3″	8′6″	17′
12	19′6″	39′	78′	57	4′1″	8′2″	16′4″
13	18′	36′	72′	60	3′11″	7′10″	15′8″
14	16′9″	33′5″	66′10″	65	3′7″	7′2″	14′4″
15	15′7″	31′2″	62′4″	68	3′5″	6′10″	13′8″
16	14′7″	29′2″	58′4″	70	3′4″	6′7″	13′2″
17	13′9″	27′6″	55′	75	3′1″	6′2″	12′4″
18	13′	26′	52′	80	3′	5′11″	11′10″

REFERENCE LIST

There are many other antennas that can be constructed. If you'd care to become an expert, we recommend the following reading material.

- TM 11-666 Antennas and Radio Propagation
- FM 24-18 Field Radio Techniques
- FM 24-21 Tactical Multichannel Radio Communications Techniques
- FM 31-20 Special Forces Operational Techniques
- FM 31-73 Advisor Hand Book For Stability Operations
- TM 11-486-6 Electrical Communications Systems Engineering-Radio

Appendix N — Radiotelephone Procedures

Voice transmission is normally used for short-distance tactical communication. It provides rapid, person-to-person communication in highly mobile situations. Radio transmissions are considered secure only when the radio is used with its associated security equipment or authorized operations codes. However, even the simple act of keying a transmitter gives the enemy useful information. Basic rules essential to transmission security must be strictly enforced on all military radiotelephone circuits. Radiotelephone procedures are based on the ACP 125 ( ) series.

SECTION I. GENERAL

1. Net Operation. Each radiotelephone station forms part of a net in which it is connected to other stations. The net control station (NCS) maintains circuit discipline within a net.

a. Operating rules. When operating in a radiotelephone net, all operators must observe the following rules:

- Listen before transmitting to avoid interfering with other transmissions.
- Speak in natural phrases, not word by word.
- Speak slowly and distinctly at normal voice level directly into the microphone, just as you would into a conventional telephone.

b. Nets. The type of net is determined by the NCS according to the operating conditions. The types of nets are—

- Free net. In a free net, traffic is exchanged without prior permission from the NCS. A net is deemed to be a free net unless otherwise ordered by the NCS.
- Directed net. In a directed net, stations must obtain permission from the NCS prior to conducting communications with other stations.

c. Call signs. Call signs are used in radio communications to identify a communications facility, a command, an authority, or a unit.

The various types of call signs are—

- Individual—represents a single station.
- Collective—represents a predetermined group of stations within a net.
- Net—represents all stations in a net.

There are two forms of call signs. They are—

- Complete call signs. Complete call signs consist of a letter-number-letter combination and a suffix. Complete call signs must be used when opening and closing a net, entering or leaving a net, establishing contact after a prolonged silence, radio reception is poor, or when first operating in a net other than your own or your next higher headquarters.
- Abbreviated call signs. Abbreviated call signs consist of the last letter of the call sign and the suffix. Abbreviated call signs may be used only when operating in your own net or nets of the next higher headquarters, or when the net NCS so authorizes.

EXAMPLE.
Complete call sign—ALFA TWO DELTA TWO EIGHT
Abbreviated call sign—DELTA TWO EIGHT

• Stations respond to collective and net call signs in alphabetical order based on the last letter of their call sign. In some instances, such as when entering a different net or when the net has more than 26 stations, there may be more than one station whose call sign ends with the same last letter. In those situations, the numerical order of the number preceding the last letter of the call sign will determine the answering order with the lowest number answering first. When abbreviated call signs are used, the sequence of answering is the same as if complete call signs were used. If a station fails to answer within 5 seconds, the next station in sequence will answer. The station missing its turn must wait until all other stations have responded before answering.

d. Calls. The call is that portion of the transmission which identifies the station(s) being called and the station calling by their call signs. The two types of calls are—

• Single call. A single call is one in which only one call sign precedes the proword "THIS IS." The call sign may be an individual, a collective, or a net call sign.

• Multiple call. A multiple call is one in which two or more call signs precede the proword "THIS IS." Called stations answer a multiple call in order called. The calling station normally will place the call signs in alphabetical sequence.

2. Establishing a Net.

a. Tuning.

• Continuous tuned radio sets require a tuning signal to insure that all radios are on the same frequency. This frequency standard is transmitted by the NCS. When the NCS is prepared to establish communications, he will make the following transmission to the net:

ALFA TWO DELTA—ALFA TWO DELTA—THIS IS—ALFA TWO DELTA TWO EIGHT—ALFA TWO DELTA TWO EIGHT—AM ABOUT TO TRANSMIT A TUNING SIGNAL—ALFA TWO DELTA TWO EIGHT—ALFA TWO DELTA TWO EIGHT (repeats his call sign over and over for 10 seconds)—OUT (After allowing time for stations to adjust their transmitters, the NCS will open the net.)

• Detent tuned radios do not require a tuning signal, since frequencies are preset within the radio.

b. Opening a net.

• When the NCS is prepared to open the net, he will call the net and issue a challenge to the net.

EXAMPLE: ALFA TWO DELTA—THIS IS—ALFA TWO DELTA TWO EIGHT—AUTHENTICATE BRAVO LIMA—OVER

• The first station responds to the NCS, answers his challenge, and issues a challenge to him.

EXAMPLE: ALFA TWO DELTA TWO EIGHT—THIS IS—BRAVO ZERO FOXTROT ZERO SEVEN—I AUTHENTICATE HOTEL—AUTHENTICATE MIKE PAPA—OVER

• The NCS answers to the net and issues a challenge which is answered by the next station in sequence.

EXAMPLE: ALFA TWO DELTA—THIS IS—ALFA TWO DELTA TWO EIGHT—I AUTHENTICATE PAPA—AUTHENTICATE BRAVO FOXTROT—OVER

• The remaining stations respond to the net, answer the challenge, and issue a challenge for the next station. The last station does not issue a challenge as all stations will have answered a challenge at this point.

EXAMPLE: ALFA TWO DELTA—THIS IS—CHARLIE EIGHT
TANGO ONE ONE—I AUTHENTICATE LIMA—AUTHENTICATE
DELTA XRAY—OVER

ALFA TWO DELTA—THIS IS—LIMA SEVEN LIMA ZERO
NINE—I AUTHENTICATE CHARLIE—OVER

• Should a station not answer, the next station in order will wait 5 seconds and then answer. The station that missed its turn will answer last.

• The NCS will respond and indicate type of net.

EXAMPLE—FREE NET: ALFA TWO DELTA—THIS IS—
ALFA TWO DELTA TWO EIGHT—OUT

EXAMPLE—DIRECTED NET: ALFA TWO DELTA—THIS IS—
ALFA TWO DELTA TWO EIGHT—THIS IS A DIRECTED NET—
OF WHAT PRECEDENCE AND FOR WHOM ARE YOUR MESSAGES—
OVER

Note: Authentication is not required when the net is opened for the first time of a new radio day. In a high threat area where enemy ICD has been extensive normal authentication will be used.

c. Closing a net.

• When the NCS is prepared to close a net, he will call the net and issue closedown instructions.

EXAMPLE: ALFA TWO DELTA—THIS IS—ALFA TWO DELTA
TWO EIGHT—CLOSE DOWN—OVER

• The first substation responds to the NCS and issues a challenge to him.

EXAMPLE: ALFA TWO DELTA TWO EIGHT—THIS IS—
BRAVO ZERO FOXTROT ZERO SEVEN—AUTHENTICATE KILO
GOLF—OVER

• The NCS answers the challenge to the net and each station responds to the NCS indicating they have received his transmission.

EXAMPLE: ALFA TWO DELTA—THIS IS—ALFA TWO
DELTA TWO EIGHT—I AUTHENTICATE DELTA—OVER

ALFA TWO DELTA TWO EIGHT—THIS IS—BRAVO ZERO
FOXTROT ZERO SEVEN—ROGER—OUT

ALFA TWO DELTA TWO EIGHT—THIS IS—CHARLIE EIGHT
TANGO ONE ONE—ROGER—OUT

ALFA TWO DELTA TWO EIGHT—THIS IS—LIMA SEVEN
LIMA ZERO NINE—ROGER—OUT

• All stations remain on the air until the last station has responded.

3. Message Handling.

a. Message format. **Messages are transmitted in a standard 16 line message format. Each message is divided into three parts—heading, text, and ending. These parts are separated by the proword "BREAK". Each part contains components which are broken down into elements and contents. Each message transmitted will contain the three parts, but will only contain those components, elements, and contents essential to that particular message.**

PARTS	COMPONENTS	ELEMENTS	FORMAT LINE	CONTENTS
HEADING	Procedure	a. Call	1	Not used.
			2&3	Stations called-Proword EXEMPT, exempted calls.
		b. Message follows		Proword THIS IS-station calling.
		c. Transmission Identification		Proword MESSAGE.
		d. Transmission Instructions		Proword NUMBER and station serial number.
			4	Prowords RELAY TO; READ BACK; DO NOT ANSWER: WORDS TWICE; Operating Signals; Address Groups; Call Signs; Plain Language Designators.
	Preamble	Precedence; date-time group; message instructions	5	Precedence designation; Proword TIME: date and time expressed in digits and zone suffix; followed by the threeletter month abbreviation, and (if required by national authorities) the year indicated by last two digits; operating signals and proword EXECUTE TO FOLLOW.
	Address	a. Originator's Sign; Originator	6	Proword FROM. Originator's address designator.
		b. Action Addressee Sign	7	Proword TO. Action addressee designator.
		c. Information Addressee Sign; Information Addressee	8	Proword INFO. Information addressees designators.
		d. Exempted Addressee Sign; Exempted Addressee	9	Proword EXEMPT. Exempted addressee designators.
	Prefix	Accounting Information, group count	10	Accounting symbol; group count; Proword GROUPS (GROUP NO COUNT).

PARTS	COMPONENTS	ELEMENTS	FORMAT LINE	CONTENTS
SEPARATION			11	Proword BREAK
TEXT	Text	Subject Matter	12	CLEAR, UNCLASSIFIED, proword SERVICE, and/or internal instructions as appropriate; thoughts or ideas as expressed by the originator.
SEPARATION			13	Proword BREAK
ENDING	Procedure	a. Time Group b. Final Instructions c. Ending Sign	14	Proword TIME. Hours and minutes expressed in digits and zone suffix, when appropriate.
			15	Prowords WAIT, CORRECTION, AUTHENTICATION IS, MORE TO FOLLOW, Station designators. Prowords OVER, OUT.

Example of a message with most of the message format used:

FORMAT LINE	
2&3	ZULU TWO EIGHT - THIS IS - HOTEL ZERO FIVE - MESSAGE NUMBER THREE -
4	RELAY TO LIMA NINER BRAVO ZERO THREE -
5	PRIORITY - TIME ONE NINER ONE FIVE ZERO ZERO ZULU JUL 75 -
6	FROM - CHARLIE ONE HOTEL ZERO FIVE -
7	TO - LIMA NINER BRAVO ZERO THREE -
8	INFO - ECHO TWO ZULU TWO EIGHT -
11	BREAK
12	TEXT
13	BREAK
15	AUTHENTICATION IS OSCAR ALFA -
16	OVER

b. *Receipting.* Receipt is employed in direct station-to-station handling. No message is considered delivered until a receipt is obtained. The receiving station transmits a receipt after each message or string of messages when he is satisfied with their accuracy. He does this by use of the proword "ROGER."

4. Communications Security.

a. In the interest of security, transmissions by radiotelephone will be as short and concise as possible, consistent with clarity. Since personnel other than trained operators frequently operate radiotelephone equipment, all personnel must be cautioned that radiotelephone transmissions are subject to enemy interception and, when used without security equipment or operations codes, have no transmission security.

b. Adherence to prescribed procedure is mandatory. Unauthorized departures from or variations in prescribed procedures create confusion, reduce reliability and speed, and tend to nullify security precautions.

c. The following basic rules are essential to transmission security and shall be strictly enforced on all military radiotelephone circuits.

- No transmission shall be made which has not been authorized by proper authority.
- The following practices are specifically forbidden:
  Violations of radio silence.
  Unofficial conversation between operators.
  Transmitting on a directed net without permission.
  Excessive tuning and testing.
  Transmitting the operator's personal sign or name.
  Unauthorized use of plain language.
  Use of other than authorized prowords.
  Unauthorized use of plain language in place of applicable prowords or operating signals.
  Linkage or compromise of classified call signs and address groups by plain language disclosures or association with unclassified call signs.
  Profane, indecent, or obscene language.
- The following practices are to be avoided:
  Use of excessive transmitting power.
  Excessive time consumed in tuning, changing frequency, or adjusting equipment.
  Speaking at speeds beyond the capabilities of receiving operators.

d. Any station observing a security violation on the net will immediately notify the NCS or other stations concerned in accordance with established guidance provided by the NCS. Security violations detected by stations outside a net will be processed via prescribed channels in accordance with established directives. When possible, these immediate notifications will be made by secure means.

5. Operating Procedures.

a. Radio checks, signal strength, and readability.

• A station is understood to have good signal strength and readability unless otherwise notified. Strength of signals and readability will not be exchanged unless one station cannot clearly hear another station.

• A station that wishes to inform another of his signal strength and readability will do so by means of a short, concise report of actual reception, such as "weak but readable," "loud but distorted," "weak with interference," etc. Reports such as "five by five" will not be used to indicate strength and quality of reception.

• The following prowords are used in initiating and answering queries concerning signal strength and readability:

General

Radio Check	What is my signal strength and readability?
Roger	I have received your last transmission satisfactorily. The omission of comments on signal strength and readability is understood to mean that reception is loud and clear.
Nothing Heard	To be used when no reply is received from a called station.

Report of Signal Strength

Loud	Your signal is very strong.
Good	Your signal strength is good.
Weak	Your signal strength is weak.
Very Weak	Your signal strength is very weak.
Fading	At times your signal strength fades to such an extent that continuous reception cannot be relied upon.

Report of Readability

Clear	Excellent quality.
Readable	Quality is satisfactory.
Unreadable	The quality of your transmission is so bad that I cannot read you.
Distorted	Having trouble reading you because your signal is distorted.
With Interference	Having trouble reading you due to interference.
Intermittent	Having trouble reading you because your signal is intermittent.

b. Repetitions. The receiving operator requests repetition of missing or doubtful words or groups by use of the proword "SAY AGAIN." The word "REPEAT" is not used in radiotelephone procedure. (It may be used in the message text.)

c. Correcting errors.

• When an error is made by the transmitting operator, the proword "CORRECTION" will be transmitted followed by the last word, group, proword, or phrase correctly transmitted. The incorrect element is then corrected and the transmission continues.

• If the transmitting operator discovers an error has been made which was not corrected immediately, the error may be corrected following the text.

d. Canceling transmissions. During the transmission of a message and before transmitting the ending proword "OVER" or "OUT," the transmission may be canceled by use of the proword "DISREGARD THIS TRANSMISSION." If the ending proword has been transmitted, the transmission may be canceled only by another message.

e. Spelling difficult words. Difficult words in the text of plain language messages are spelled using the phonetic alphabet. Actual names of places are encoded with an operations code.

EXAMPLE: PROCEED NORTH TO VILLAGE OF CHUNG SU - I SPELL - CHARLIE HOTEL UNIFORM NOVEMBER GOLF SIERRA UNIFORM - CHUNG SU

NOTE: If the word can be pronounced, the operator will do so before and after spelling. In this case "Chung Su" is actually the encoded name for an actual village.

f. Acknowledgements. The originator of a message may desire acknowledgement from the addressee that he understands the message and is able to execute the indicated action. An acknowledgement should not be confused with a reply or receipt, although prompt reply by the addressee referring to the message may serve as an acknowledgement. If acknowledgement is desired, the request for acknowledgement is indicated in the text of the message. Acknowledgements are originated only by the addressee to whom the request for acknowledgement was made. In some cases, the addressee is operating the radio or is close to it. In these instances, when no delay in answering will result, the response by the addressee to the message may represent acknowledgement. The proword "wilco" is authorized for this method of acknowledgement. However, when this situation does not exist, the operator will receipt for the message and the acknowledgement will be sent later.

EXAMPLE: SIERRA ZERO FIVE transmits a message to VICTOR TWO ONE. VICTOR TWO ONE - THIS IS - SIERRA ZERO FIVE - MESSAGE - NUMBER ONE - PRIORITY - TIME TWO FIVE ONE FIVE ONE FIVE ZULU JULY SEVEN FIVE - BREAK - MOVE TO ALTERNATE POSITION - ACKNOWLEDGE - BREAK - OVER

If the addressee is operating his own radio set, he will respond and request authentication.

THIS IS VICTOR TWO ONE - AUTHENTICATE ALFA KILO - OVER

If the radio operator is operating, he will receipt for the message and give it to the addressee.

When the addressee is ready to acknowledge, he informs his operator who transmits:

SIERRA ZERO FIVE - THIS IS - VICTOR TWO ONE - YOUR NUMBER ONE TIME TWO FIVE ONE FIVE ONE FIVE ZULY JULY SEVEN FIVE ACKNOWLEDGED - TIME ONE FIVE FOUR FIVE ZULU - OVER

The receiving operator receipts and passes the information to the originator.

g. Verifications. The addressee may desire that a message or portions of a message be verified by the originator for correctness.

EXAMPLE: The addressee at DELTA ZERO SEVEN has received a message from ALFA ONE THREE. He informs his operator to obtain a verification of the message heading. The operator transmits:

ALFA ONE THREE - THIS IS - DELTA ZERO SEVEN - VERIFY YOUR ONE ZERO ZERO EIGHT ZERO ONE ZULU JULY SEVEN FIVE - ALL BEFORE BREAK - OVER

The receiving operator receipts for this transmission, checks with the originator, and transmits the correct portion. This is always the response whether a mistake was corrected or not.

DELTA ZERO SEVEN - THIS IS - ALFA ONE THREE - I VERIFY MY ONE ZERO ZERO EIGHT ZERO ONE ZULU JULY SEVEN FIVE - ALL BEFORE BREAK - DELTA ZERO SEVEN - THIS IS - ALFA ONE THREE - PRIORITY - TIME ONE ZERO ZERO EIGHT ZERO ONE ZULU JULY SEVEN FIVE - FROM ALFA ONE THREE - TO DELTA ZERO SEVEN - BREAK - OVER

SECTION II. PROWORDS

6. Prowords are pronounceable words or phrases which have been assigned meanings for the purpose of expediting message handling on circuits where radiotelephone procedure is employed. In *no* case shall a proword or a combination of prowords be substituted for the textual content of a message. For radiotelephone communications between units of different nationalities, the prowords may be replaced by their equivalent prosigns, where these exist, spelled out using the authorized phonetic equivalents.

Proword	Explanation	Equivalent To
ADDRESS GROUP	The group that follows is an address group.	
ALL AFTER	The portion of the message to which I have reference is all that which follows .	AA
ALL BEFORE	The portion of the message to which I have reference is all that which precedes .	AB
AUTHENTICATE	The station called is to reply to the challenge which follows.	
AUTHENTICATION IS	The transmission authentication of this message is	
BREAK	I hereby indicate the separation of the text from other portions of the message.	BT
BROADCAST YOUR NET	Link the two nets under your control for automatic rebroadcast.	
CALL SIGN	The group that follows is a call sign.	
CORRECT	You are correct or what you have transmitted is correct.	C

Proword	Explanation	Equivalent To
CORRECTION	An error has been made in this transmission. Transmission will continue with the last word correctly transmitted.	EEEEEEEE
	An error has been made in the transmission (or message indicated). The correct version is	C
	That which follows is a corrected version in answer to your request for verification.	C
DISREGARD THIS TRANSMISSION-OUT	This transmission is in error. Disregard it. This proword shall not be used to cancel any message that has been completely transmitted and for which receipt or acknowledgement has been received.	EEEEEEEE AR
DO NOT ANSWER	Stations called are not to answer this call, receipt for this message, or otherwise to transmit in connection with this transmission. When this proword is employed, the transmission shall be ended with the proword "OUT."	F
EXECUTE	Carry out the intent of the message or signal to which this applies. To be used only with the Executive Method.	IX (5 sec dash)
EXECUTE TO FOLLOW	Action on the message or signal which follows is to be carried out upon receipt of the proword "EXECUTE." To be used only with the Delayed Executive Method.	IX
EXEMPT	The addressees immediately following are exempted from the collective call.	XMT
FIGURES	Numerals or numbers follow.	
FLASH	Precedence FLASH.	Z
FROM	The originator of this message is indicated by the address designator immediately following.	FM
GROUPS	This message contains the number of groups indicated by the numeral following.	GR
GROUP NO COUNT	The groups in this message have not been counted.	GRNC
I AUTHENTICATE	The group that follows is the reply to your challenge to authenticate.	
IMMEDIATE	Precedence IMMEDIATE.	O

Proword	Explanation	Equivalent To
IMMEDIATE EXECUTE	Action on the message or signal following is to be carried out on receipt of the word "EXECUTE." To be used only with the Immediate Executive Method.	IX
INFO	The addressees immediately following are addressed for information.	INFO
I READ BACK	The following is my response to your instruction to read back.	
I SAY AGAIN	I am repeating transmission or portion indicated.	IMI
I SPELL	I shall spell the next word phonetically.	
I VERIFY	That which follows has been verified at your request and is repeated. To be used only as a reply to VERIFY.	
MESSAGE	A message which requires recording is about to follow. Transmitted immediately after the call. (This proword is not used on nets primarily employed for conveying messages. It is intended for use when messages are passed on tactical or reporting nets.)	
MORE TO FOLLOW	Transmitting station has additional traffic for the receiving station.	B
NUMBER	Station serial number.	NR
OUT	This is the end of my transmission to you and no answer is required or expected.	AR
OVER	This is the end of my transmission to you and a response is necessary. Go ahead; transmit.	K
PRIORITY	Precedence PRIORITY.	P
READ BACK	Repeat this entire transmission back to me exactly as received.	G
RELAY (TO)	Transmit this message to all addressees (or addressees immediately following this proword). The address component is mandatory when this proword is used.	T
ROGER	I have received your last transmission satisfactorily.	
ROUTINE	Precedence ROUTINE.	R
SAY AGAIN	Repeat all of your last transmission.	IMI

Proword	Explanation	
SERVICE	The message that follows is a SERVICE message.	SVC
SIGNALS	The groups which follow are taken from a signal book. (This proword is not used on nets primarily employed for conveying signals. It is intended for use when tactical signals are passed on nontactical nets.)	HM HM HM
SILENCE (Repeated three or more times.)	Cease transmission on this net immediately. Silence will be maintained until lifted. (When an authentication system is in force, the transmission imposing silence is to be authenticated.)	
SILENCE LIFTED	Silence is lifted. (When an authentication system is in force, the transmission lifting silence is to be authenticated.)	
SPEAK SLOWER	Your transmission is too fast a speed. Reduce speed of transmission.	
STOP REBROADCASTING	Cut the automatic link between the two nets that are being rebroadcast and revert to normal working.	
THIS IS	This transmission is from the station whose designator immediately follows.	DE
TIME	That which immediately follows is the time or date-time group of the message.	
TO	The addressees immediately following are addressed for action.	TO
UNKNOWN STATION	The identity of the station with whom I am attempting to establish communication is unknown.	AA
VERIFY	Verify entire message (or portion indicated) with the originator and send correct version. To be used only at the discretion of or by the addressee to which the questioned message was directed.	J
WAIT	I must pause for a few seconds.	AS
WAIT-OUT	I must pause longer than a few seconds.	AS AR
WILCO	I have received your signal, understand it, and will comply. To be used only by the addressee. Since the meaning of ROGER is included in that of WILCO, the two prowords are never used together.	

Proword	Explanation	
WORD AFTER	The word of the message to which I have reference is that which follows _____.	WA
WORD BEFORE	The word of the message to which I have reference is that which precedes _____.	WB
WORDS TWICE	Communication is difficult. Transmit(ting) each phrase (or each code group) twice. This proword may be used as an order, request, or as information.	
WRONG	Your last transmission was incorrect. The correct version is _____.	

SECTION III.

PHONETIC ALPHABET AND NUMERALS

7. Phonetic Alphabet. When necessary to identify any letter of the alphabet, the standard phonetic alphabet shall be used. This alphabet is listed below.

Letter	Phonetic	Spoken As	Letter	Phonetic	Spoken As
A	ALFA	AL FAH	N	NOVEMBER	NO VEM BER
B	BRAVO	BRAH VOH	O	OSCAR	OSS CAH
C	CHARLIE	CHAR LEE or SHAR LEE	P	PAPA	PAH PAH
			Q	QUEBEC	KEH BECK
D	DELTA	DELL TAH	R	ROMEO	ROW ME OH
E	ECHO	ECK OH	S	SIERRA	SEE AIR RAH
F	FOXTROT	FOKS TROT	T	TANGO	TANG GO
G	GOLF	GOLF	U	UNIFORM	YOU NEE FORM or OO NEE FORM
H	HOTEL	HOH TELL			
I	INDIA	IN DEE AH	V	VICTOR	VIK TAH
J	JULIETT	JEW LEE ETT	W	WHISKEY	WISS KEY
K	KILO	KEY LOH	X	XRAY	ECKS RAY
L	LIMA	LEE MAH	Y	YANKEE	YANG KEY
M	MIKE	MIKE	Z	ZULU	ZOO LOO

(NOTE: Syllables underlined carry the accent.)

8. Pronunciation of Numerals.

a. To distinguish numerals from words similarly pronounced, the proword "FIGURES" may be used preceding such numbers.

b. When numerals are transmitted by radiotelephone, the following rules for their pronunciation will be observed:

Numeral	Spoken As	Numeral	Spoken As
0	ZE-RO	5	FIFE
1	WUN	6	SIX
2	TOO	7	SEV-EN
3	TREE	8	AIT
4	FOW-ER	9	NIN-ER

c. Numbers will be transmitted digit by digit except that exact multiples of thousands may be spoken as such. However, there are special cases, such as Anti-Air Warfare reporting procedures when the normal pronunciation of numerals is prescribed and this rule does not apply. For example, 17 would then be "seventeen."

Numeral	Spoken As	Numeral	Spoken As
44	FOW-ER FOW-ER	1478	WUN FOW-ER SEV-EN AIT
90	NIN-ER ZE-RO	7000	SEV-EN TOU-SAND
136	WUN TREE SIX	16000	WUN SIX TOU-SAND
500	FIFE ZE-RO ZE-RO	812681	AIT WUN TOO SIX AIT WUN

d. The decimal point is to be spoken as "DAY-SEE-MAL."

EXAMPLE: 123.4 is to be spoken as "WUN TOO TREE DAY-SEE-MAL FOW-ER."

e. Dates shall be spoken digit by digit, with the months in full.

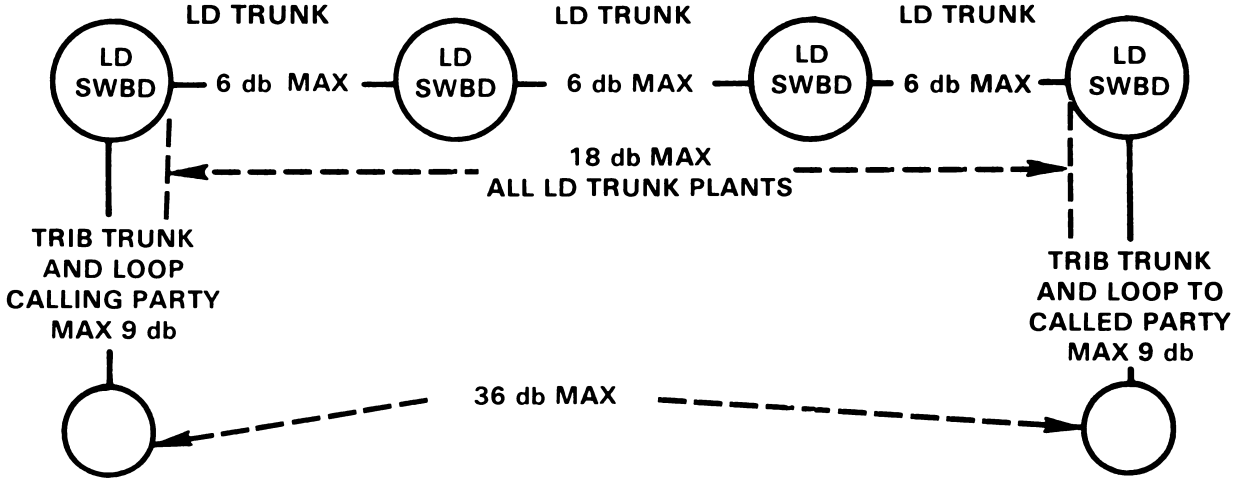
EXAMPLE: "20 Aug" is spoken as "TOO ZE-RO AUGUST."

Appendix O — Telephone Network Planning

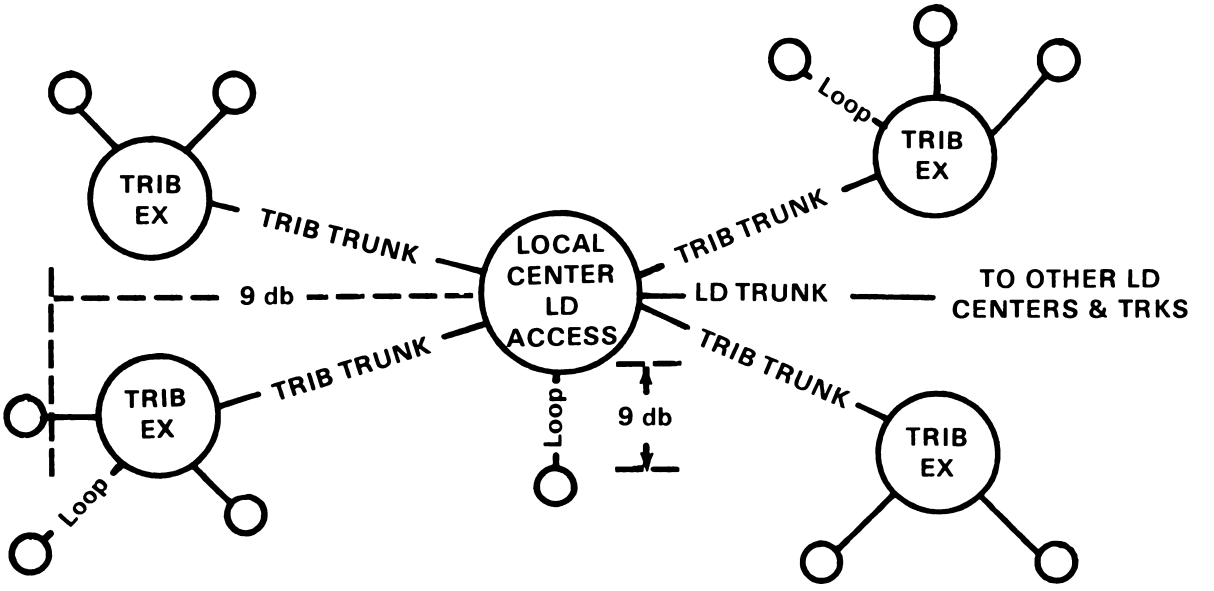
To insure that a conversation between two telephones will be satisfactory, the circuit loss linking telephones must be low enough for the speech to be heard and understood. Telephone network planning provides an orderly method of allocating these losses in the various circuits of any communications network. Therefore it insures satisfactory intercommunication between any two points in a network. With present-day military telephones, the maximum allowable loss of the overall circuit between two or more telephones SHOULD NOT EXCEED 36db.

A. MANUAL TELEPHONE NETWORKS: Manual telephone networks are divided into two main categories.

1. LONG DISTANCE (LD) NETWORK-provides interconnection between the local area networks and includes LD trunks and switching centers. To provide a circuit path for a call originating in one local network area to a called party in a distant local network area may require interconnection of several LD trunks in tandem. The nominal loss of one LD grade trunk is 3 db from switchboard to switchboard. In certain cases, the maximum allowable loss may be increased to 6 db per LD trunk. The total allowable loss for all the long distance trunk plant in a built-up connection is 18 db.



2. LOCAL AREA NETWORK-serves subscribers through a system of loops, tributary exchanges, and tributary and terminal trunks. It provides ONE switching center with long distance access to distant local area networks. The maximum allowable loss (loop loss plus tributary trunk loss) for subscribers requiring access to the long distance network is 9 db. This loss is called the "tributary loss."



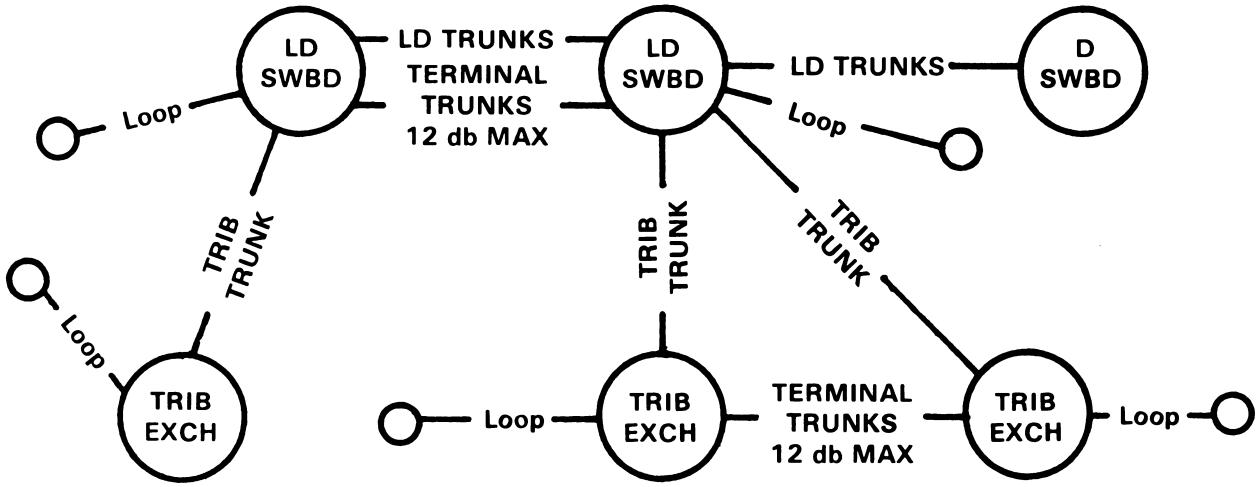
NOTE: In certain cases, a tributary exchange may not have a direct trunk group to a long distance or local center, and must complete long distance calls by way of an intervening tributary exchange. Of the allowable 9 db tributary loss, no more than 6 db should be used by the tributary trunks in tandem, which allows at least a 3 db loss to the loop plant. Thus, two important elements in planning the circuit layout of the local network are:

— No more than two tributary trunks should be switched in tandem.

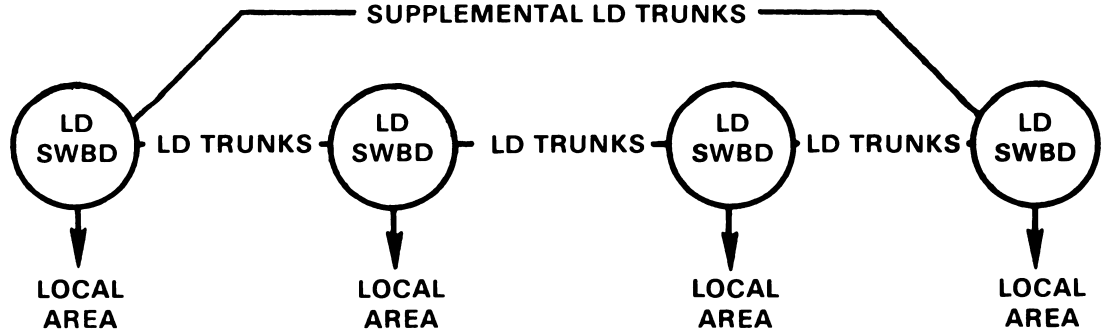
— Always allow at least 3 db loss for loop planning in the tributary area.

B. SPECIAL TRUNKS AND CIRCUITS IN MANUAL NETWORKS:

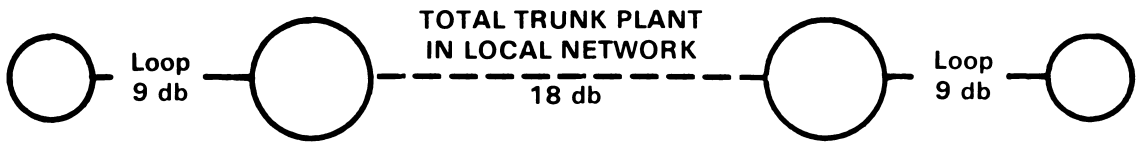
1. TERMINAL TRUNKS-terminal grade trunks may have a maximum loss of 12 db and are used to provide for high volume traffic between the exchanges or between areas where the trunks terminate. Terminal trunks may be connected to loops or tributary trunks, but NEVER to LD trunks or to other terminal trunks.



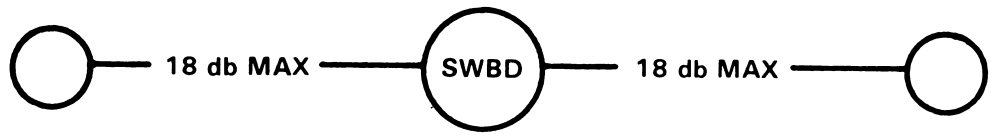
2. SUPPLEMENTAL TRUNKS: Supplemental trunks are used to interconnect widely separate LD switching centers and bypass intermediate switching points. Supplemental trunks permit the completion of very long distance calls without interconnecting an excessive number of LD trunks, and can be switched to loops, tributary trunks, or LD trunks.



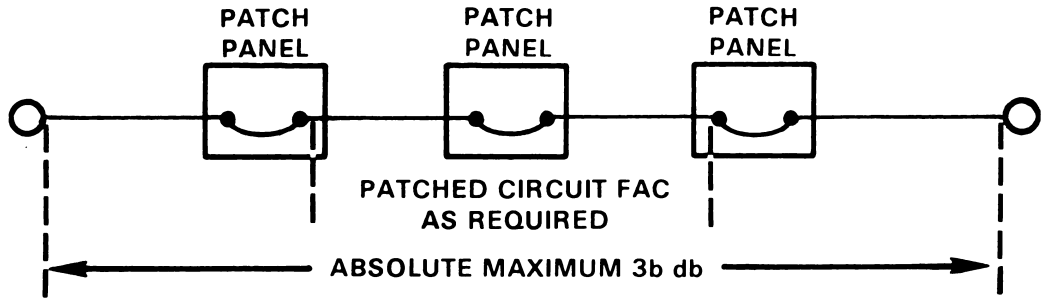
3. SPECIAL CIRCUITS: The maximum allowable loss for loops which do NOT require access to long distance networks, but do require switching within the local network, is 9 db.



—The maximum allowable loss in loops connected only to other loops is 18 db.



—For direct, patched, private-line or user-to-user circuits, the loss must not exceed 36 db.



C. AUTOMATIC TELEPHONE NETWORKS: The maximum allowable loss for all terminations in tactical automatic switched networks, at either an AN/TTC-25 or AN/TTC-38, is 10 db. This applies to local, dual tone, multifrequency telephone instruments; trunks circuits; and all special circuits.

Appendix P — Joint Electronics Type Designation System (JETDS)

1. A COMPLETE SET — **AN/GRC-106 A (X, Y OR Z) (V)**

   Indicates "JETDS" system
   Installation
   Type of Equipment
   Purpose
   Model Number
   Modification Letter
   Changes in Voltage, Phase of Frequency
   Variable Grouping

2. SAMPLE OF A COMPONENT USED WITH A PARTICULAR SET: RT-662/GRC-106A

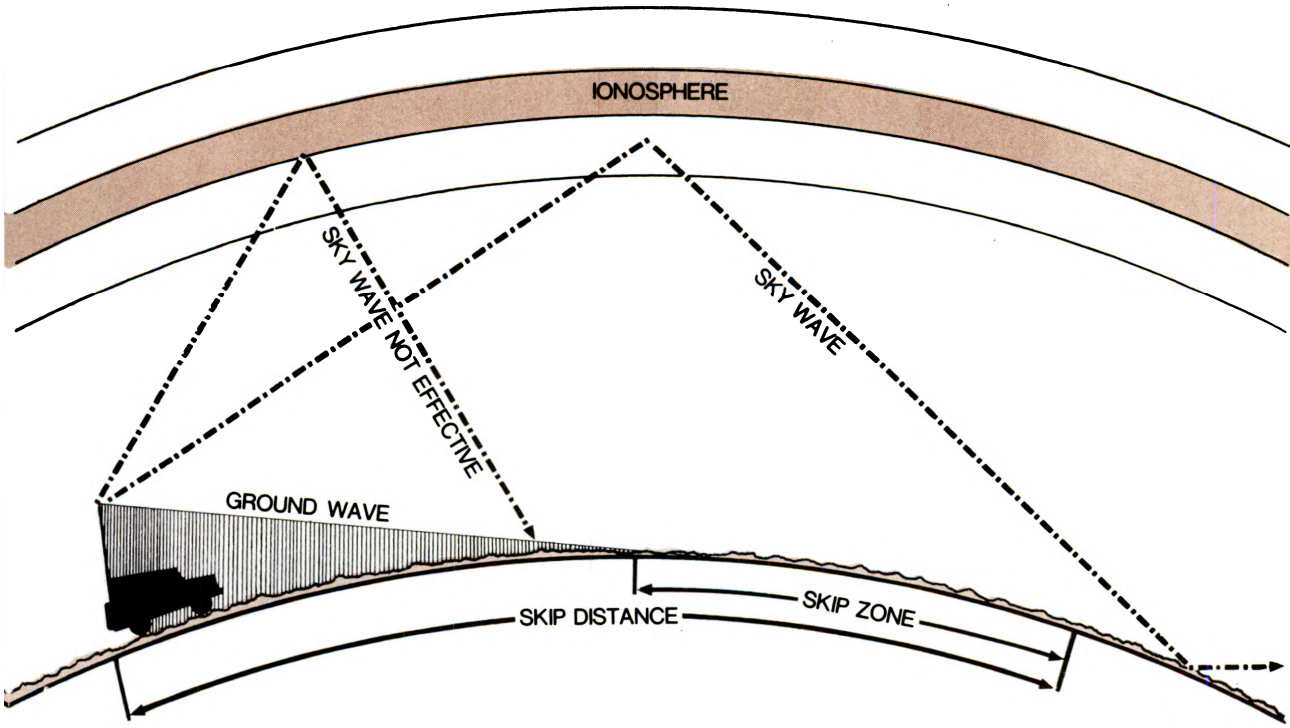
3. SAMPLE OF A COMPONENT NOT USED WITH A PARTICULAR SET: S-69/GRC

4. TABLE OF SET OR EQUIPMENT INDICATOR LETTERS:

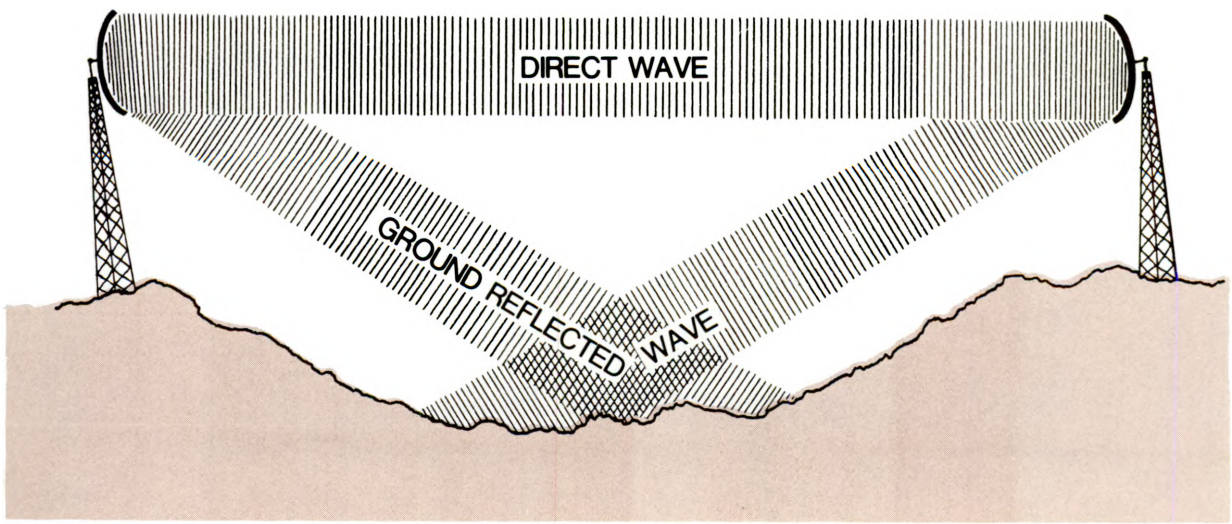
INSTALLATION	TYPE	PURPOSE
A - Piloted aircraft	A - Invisible light, heat radiation	B - Bombing
B - Underwater mobile, submarine	C - Carrier	C - Communications
D - Pilotless carrier	D - Radiac	D - Direction finder reconnaissance and/or surveillance
F - Fixed ground	G - Telegraph or teletype	E - Ejection and/or release
G - General ground use	I - Interphone and public address	G - Fire control or searchlight directing
K - Amphibious	J - Electromechanical or inertial wire covered	H - Recording and/or reproducing
M - Mobile (ground)	K - Telemetering	K - Computing
P - Portable	L - Countermeasures	M - Maintenance and/or test assemblies
S - Water	M - Meteorological	N - Navigational aids
T - Transportable (ground)	N - Sound in air	Q - Special or combination of purposes
U - General utility	P - Radar	R - Receiving, passive detecting
V - Vehicular (ground)	Q - Sonar and underwater sound	S - Detecting and/or range and bearing, search
W - Water surface and underwater comb.	R - Radio	T - Transmitting
Z - Piloted-pilotless airborne vehicle combination	S - Special or combinations of types	W - Automatic flight or remote control
	T - Telephone (wire)	X - Identification and recognition
	V - Visual and visible light	
	W - Armament	
	X - Facsimile or television	
	Y - Data Processing	

Appendix Q — Radio Propagation and Atmospheric Ionization Data

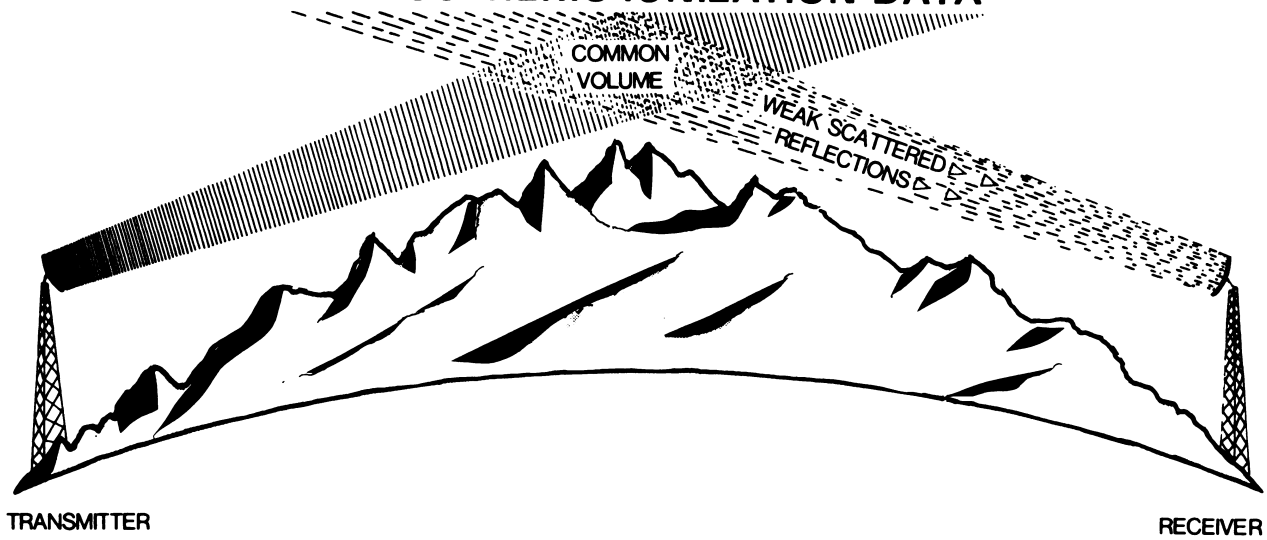
GROUND WAVE & SKY WAVE TRANSMISSION PATH



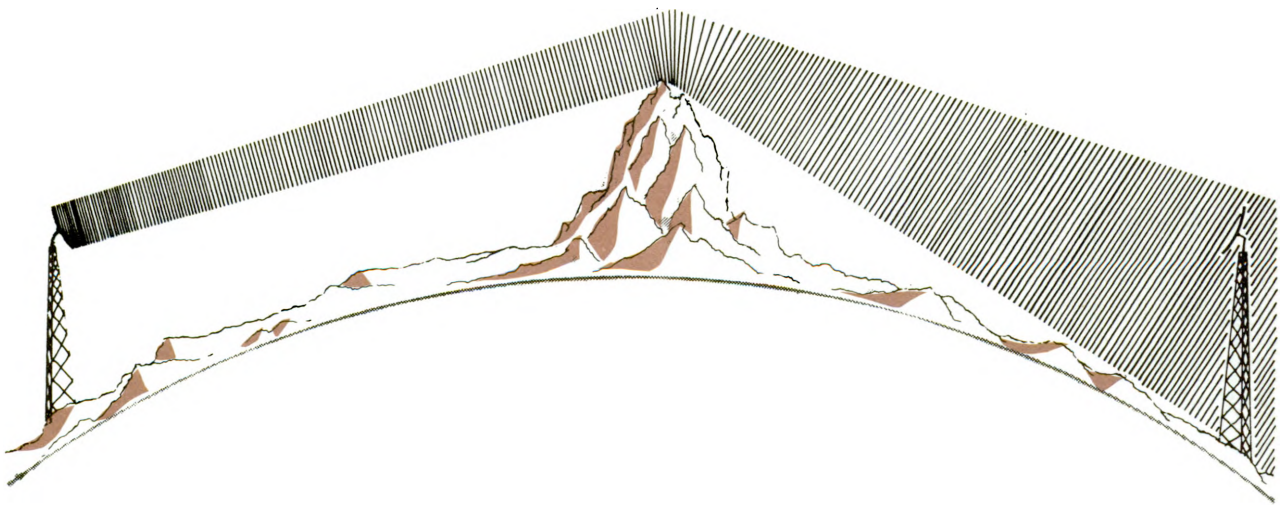
DIRECT WAVE & REFLECTIVE WAVE TROPO



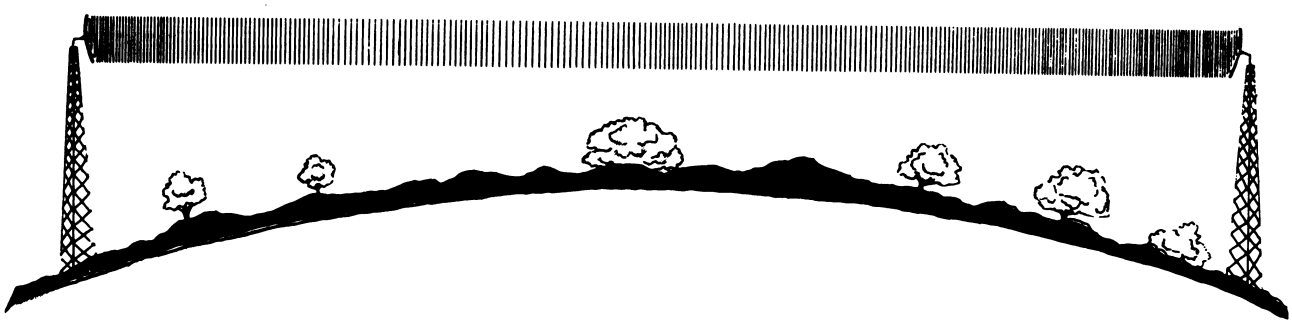
ATMOSPHERIC IONIZATION DATA



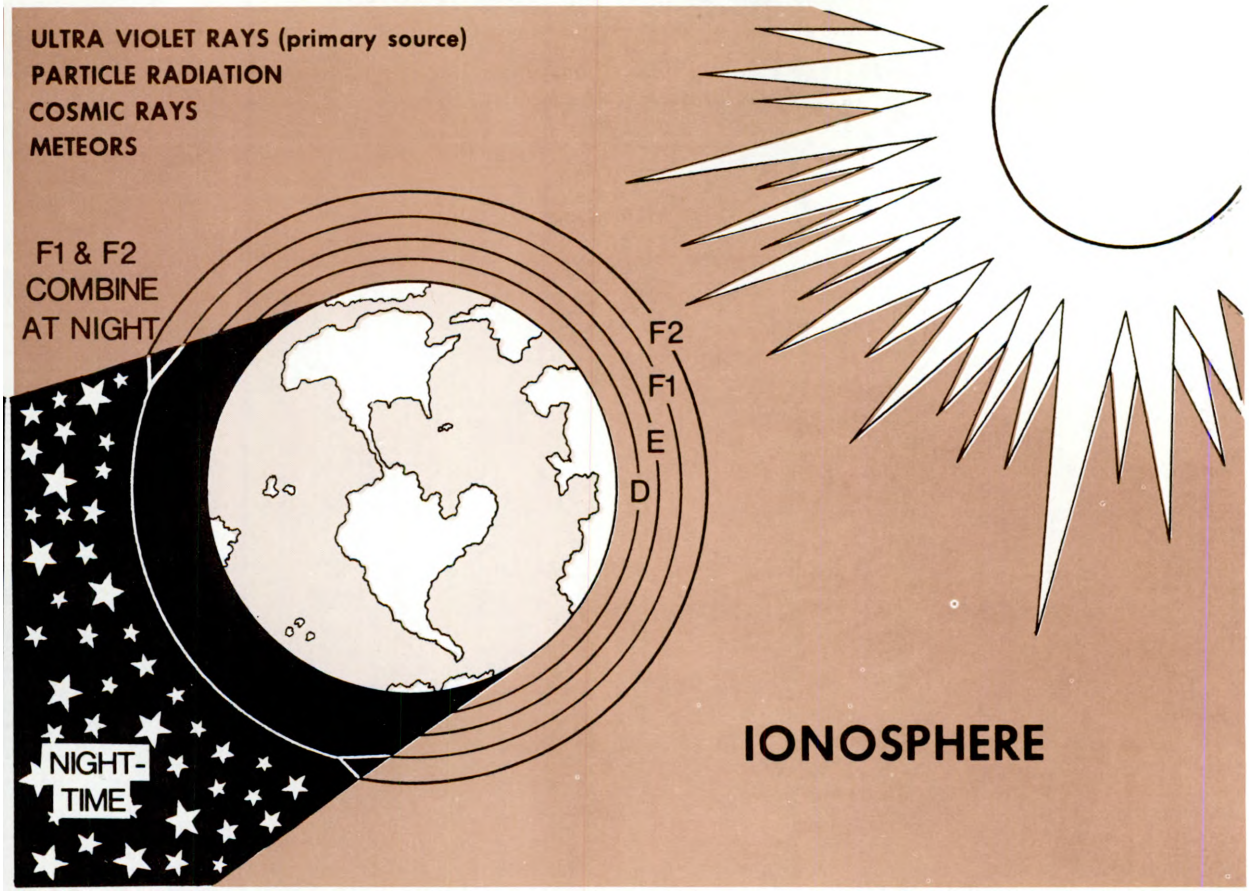
OBSTACLE GAIN



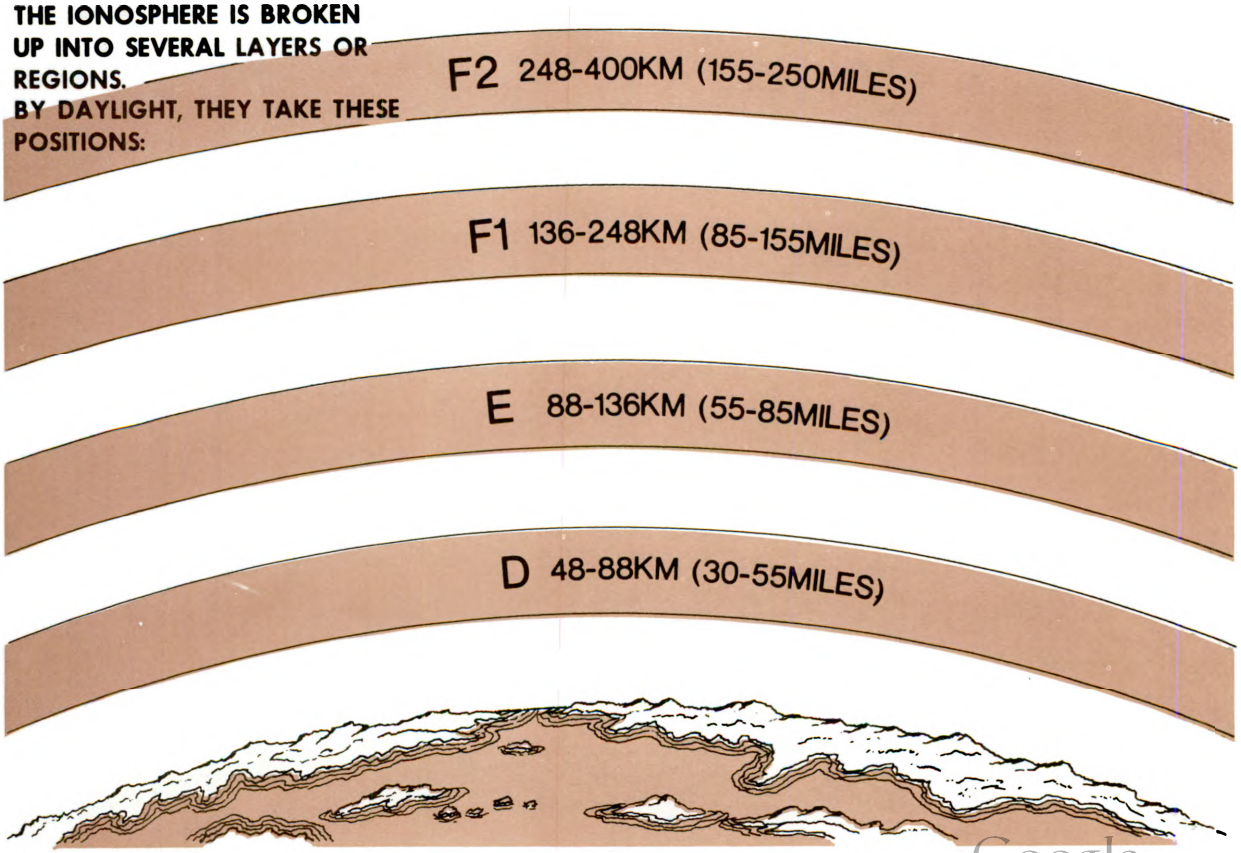
LINE OF SIGHT



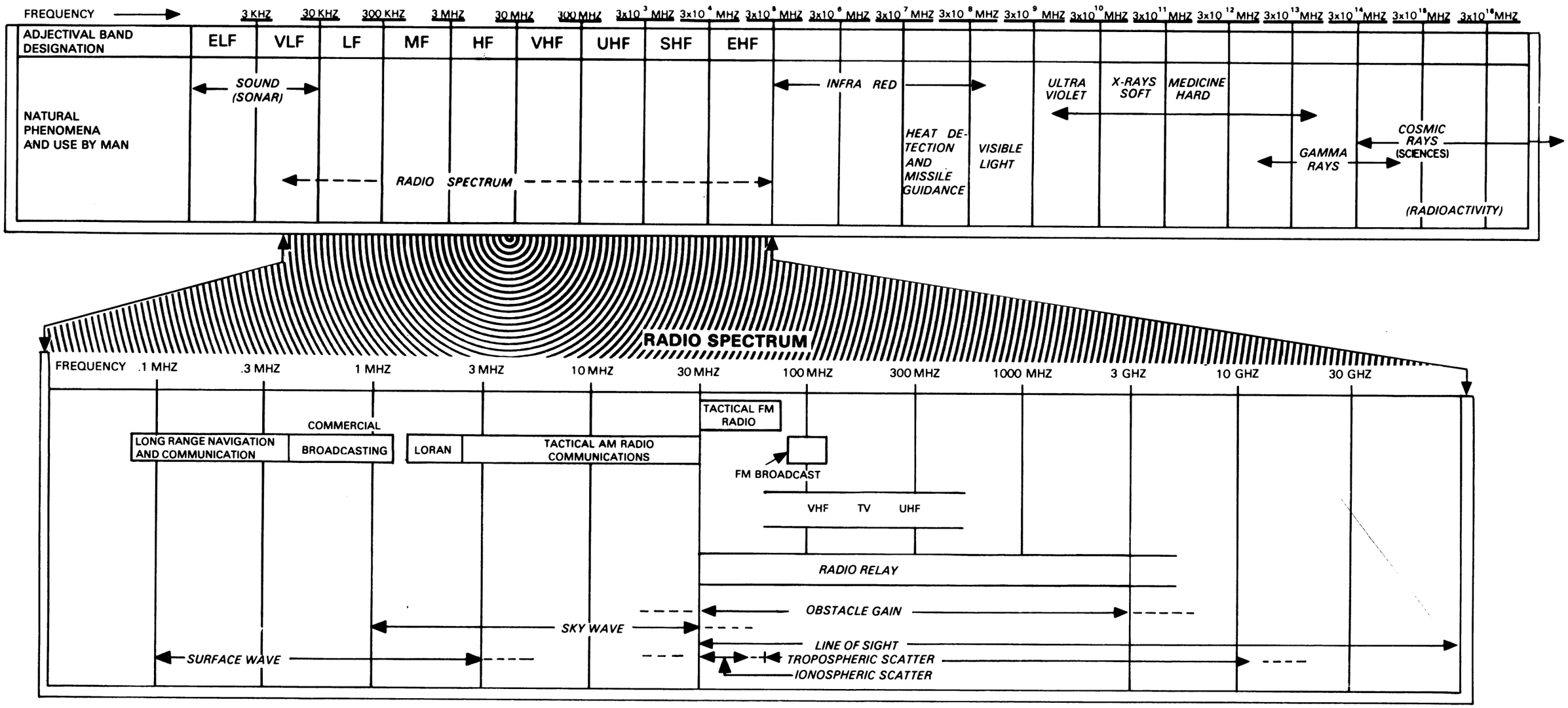
TROPOSPHERIC SCATTER



THE IONOSPHERE IS BROKEN UP INTO SEVERAL LAYERS OR REGIONS. BY DAYLIGHT, THEY TAKE THESE POSITIONS:

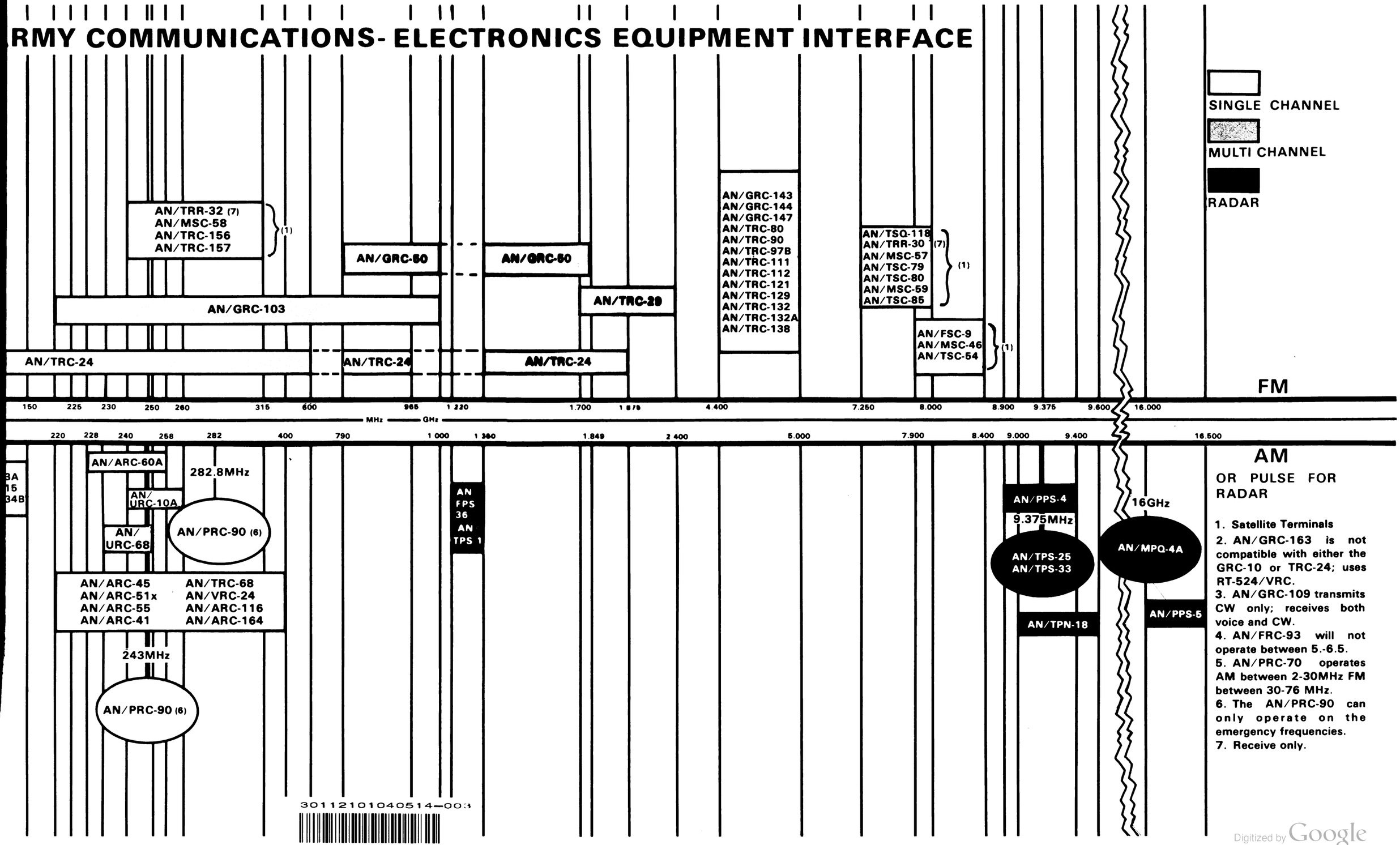


ELECTROMAGNETIC SPECTRUM



Appendix R — Electromagnetic Spectrum and Army C-E Equipment Interface Charts

RMY COMMUNICATIONS- ELECTRONICS EQUIPMENT INTERFACE

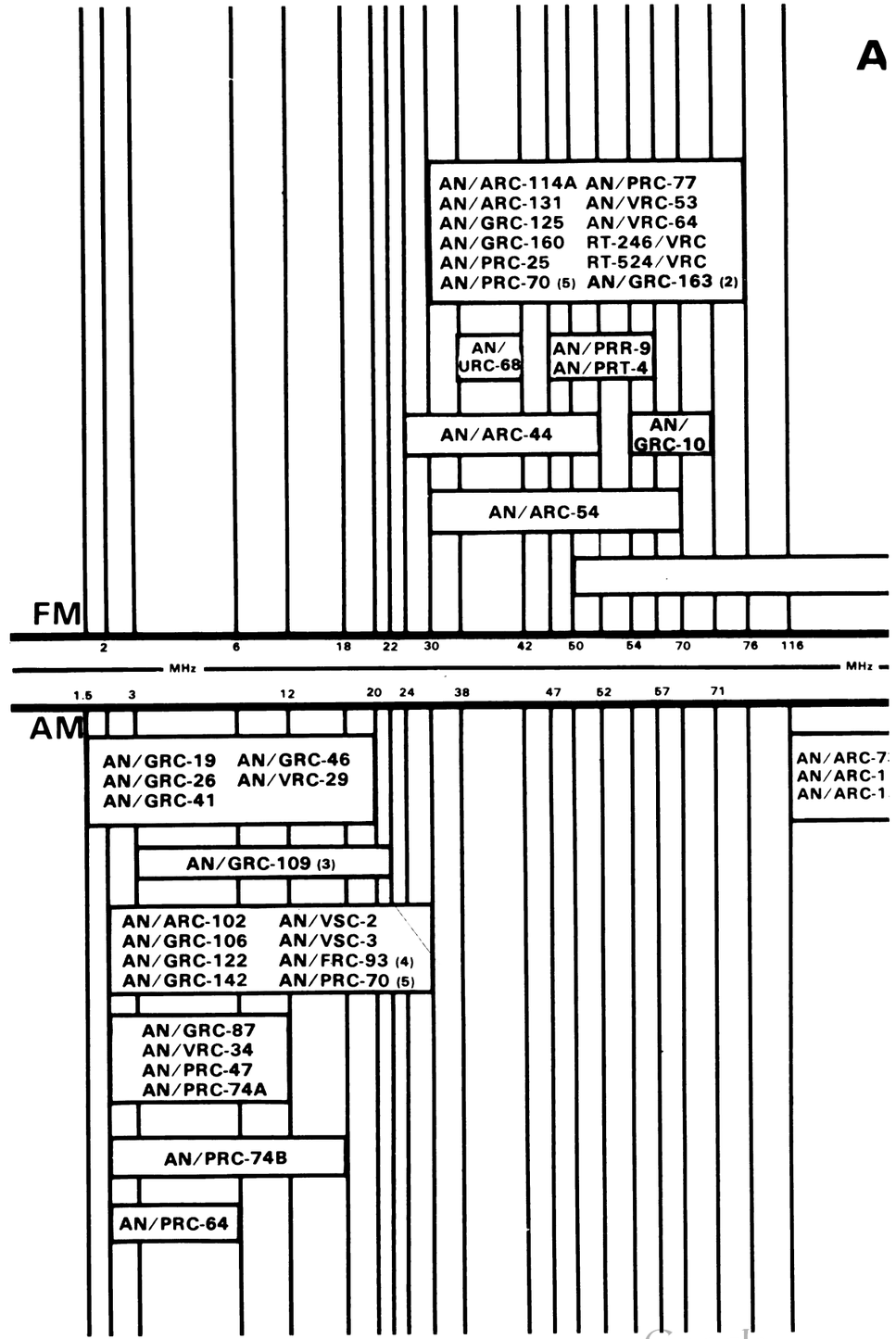


AM

OR PULSE FOR RADAR

1. Satellite Terminals
2. AN/GRC-163 is not compatible with either the GRC-10 or TRC-24; uses RT-524/VRC.
3. AN/GRC-109 transmits CW only; receives both voice and CW.
4. AN/FRC-93 will not operate between 5.-6.5.
5. AN/PRC-70 operates AM between 2-30MHz FM between 30-76 MHz.
6. The AN/PRC-90 can only operate on the emergency frequencies.
7. Receive only.

Appendix R — Electromagnetic Spectrum and Army C-E



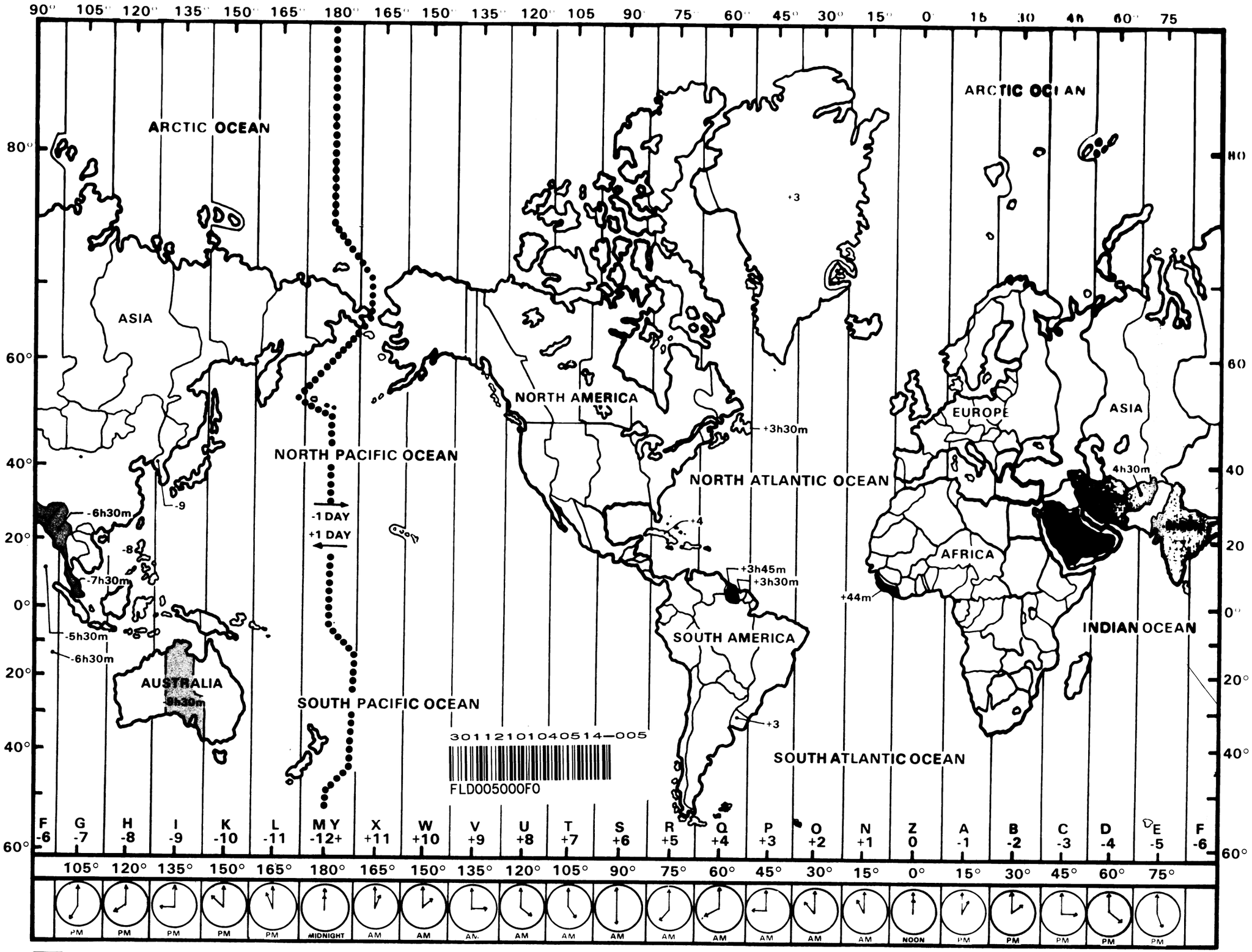
Time Conversion Table

PREVIOUS DAY																									SAME DAY
1800	1900	2000	2100	2200	2300	2400	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	
1900	2000	2100	2200	2300	2400	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	
2000	2100	2200	2300	2400	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	
2100	2200	2300	2400	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	
2200	2300	2400	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	
2300	2400	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	
2400	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	
0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	0100	
0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	0100	0200	
0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	0100	0200	0300	
0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	0100	0200	0300	0400	
0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	0100	0200	0300	0400	0500	
0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	0100	0200	0300	0400	0500	0600	
0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	0100	0200	0300	0400	0500	0600	0700	NEXT DAY
0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	0100	0200	0300	0400	0500	0600	0700	0800	
0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	0100	0200	0300	0400	0500	0600	0700	0800	0900	
1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	
1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	
1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	
1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	
1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	
1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	
1600	1700	1800	1900	2000	2100	2200	2300	2400	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	
1700	1800	1900	2000	2100	2200	2300	2400	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	
SAME DAY																									NEXT DAY

Y	X	W	V	U	T	S	R	Q	P	O	N	Z	A	B	C	D	E	F	G	H	I	K	L	M
+12	+11	+10	+9	+8	+7	+6	+5	+4	+3	+2	+1	0	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10	-11	-12

Appendix S — Time Conversion Table

STANDARD TIME ZONES OF THE WORLD



Even numbered zone

Odd numbered zone

Half hour zone

Countries and areas which have not adopted zone system, or where time differs other than half hour from neighboring zones.

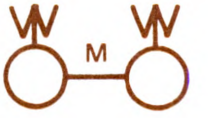
Appendix T — Time Zone Chart

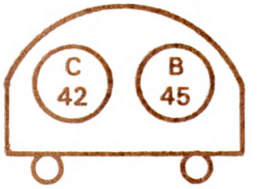
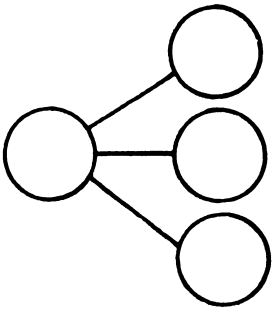
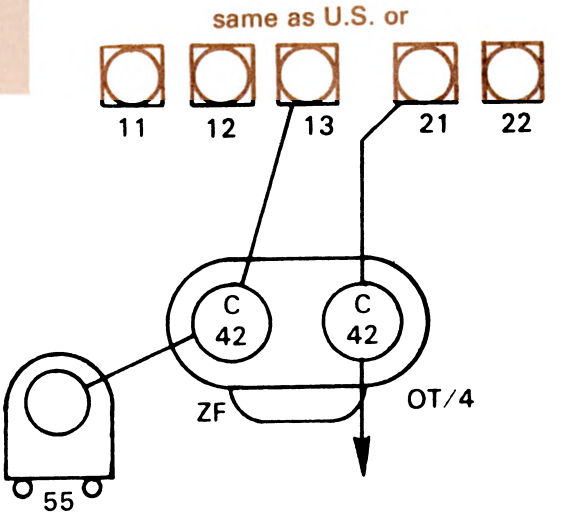
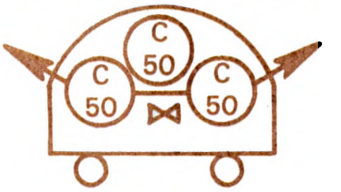
Appendix U — C-E Symbols

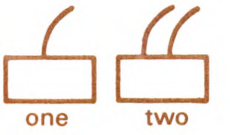
This appendix has incorporated the C-E symbols approved for use by the Standardization Agreement (STANAG) of the member nations of NATO, CENTO and SEATO. The STANAG symbols are presented here for the purpose of recognition and use as appropriate.

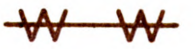
SERIAL	EXPLANATION OF SYMBOL	SYMBOL U.S.	SYMBOL STANAG
RADIO:			
1	General symbol for radio equipment.		same
2	Single channel transmitter or receiver (May be used to indicate a Single Channel Radio Access (SCRA) terminal (subscribers station where appropriate.)	same	
3	Single channel transmitter or receiver of the Combat Net Radio type.		same
4	Single channel transmitter or receiver telephony operation (May be used to indicate a single channel SCRA radio central station where appropriate.)	same	
5	Multichannel transmitter or receiver (May be used to indicate a multichannel SCRA radio central station where appropriate.	same	

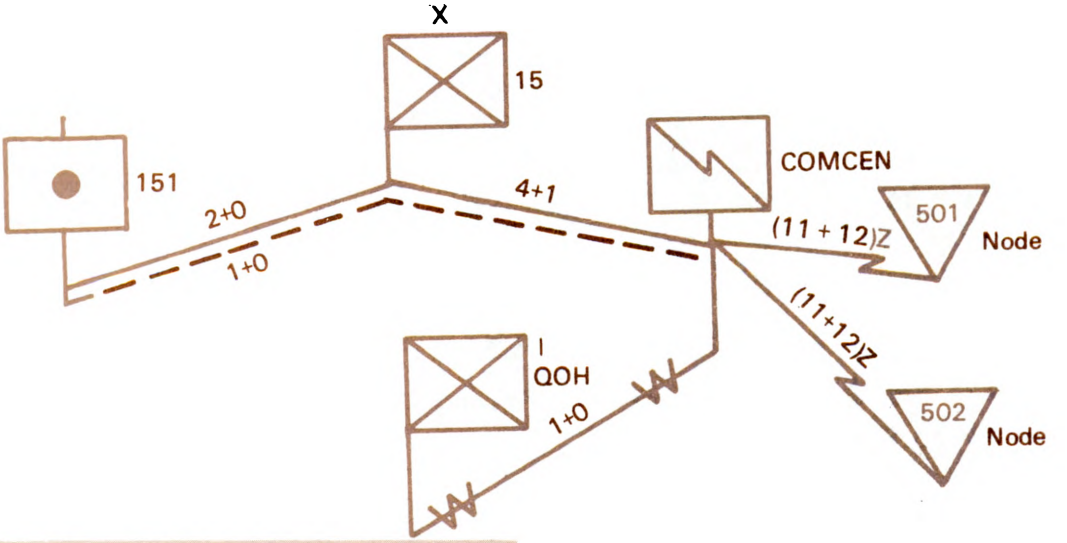
SERIAL	EXPLANATION OF SYMBOL	SYMBOL U.S.	SYMBOL STANAG
6	Multichannel Line of Sight (LOS) Radio Relay equipment or station.	same	
7	Multichannel, Tropospheric (Forward) Scatter equipment or station.	same	
8	Multichannel Satellite Earth station.	same	
9	Radio relay station.	same	
10	Radio direction finding station.		same
11	Radio intercept or monitoring station.		same
12	Dummy Radio station.		

SERIAL	EXPLANATION OF SYMBOL	SYMBOL U.S.	SYMBOL STANAG
13	Radio-wire integration station.		
14	Communications jamming station.		same
15	Multipurpose jammer.		
16	Radar station.		
17	Automatically switched simplex rebroadcast station.		
18	Manually switched simplex rebroadcast station.		

SERIAL	EXPLANATION OF SYMBOL	SYMBOL U.S.	SYMBOL STANAG
19	Duplex rebroadcast station.		
20	Interface box.		
21	Interface between an SCRA terminal station and a net radio equipment with manual switching.		
22	C42 and B45 radio equipment co-located in an operational (non-armored) wheeled vehicle.		
23	Radio net systems.		same as U.S. or 
24	Mobile radio relay station with standby equipment.		

SERIAL	EXPLANATION OF SYMBOL	SYMBOL U.S.	SYMBOL STANAG
25	Remote control equipment.		
26	Antenna equipment for FM Voice (RC-292) *Three or more indicate number.		
27	A radio equipment type D11 mounted in an operational (non-armored) wheeled vehicle.		
28	A radio station under national control.		
29	Co-located equipment.		
	Symbols used in Field Manual diagrams (radio systems).		
30	FM Voice	see #34	
31	AM/SSB Voice		
32	AM/SSB RATT		
33	External Net		

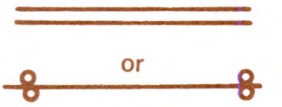
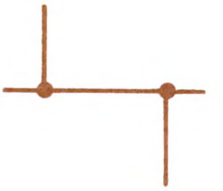
SERIAL	EXPLANATION OF SYMBOL	SYMBOL U.S.	SYMBOL STANAG
34	Combat radio net link		
35	Radio relay link		
36	Tropospheric link		
37	Satellite link		
38	Communications diagram (STANAG):		

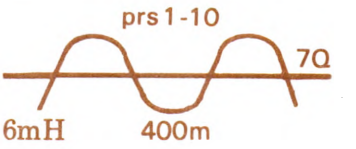
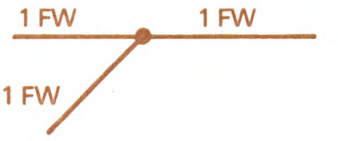
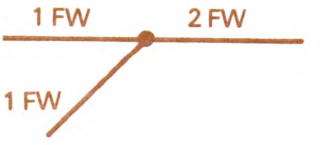
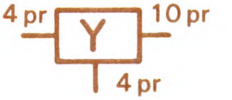


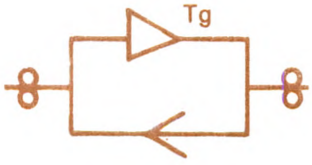
a. Shows only point to point facilities.

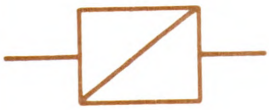
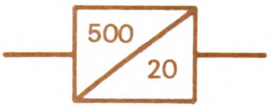
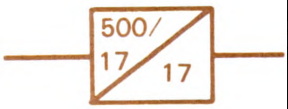
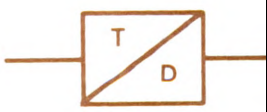
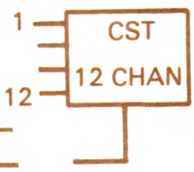
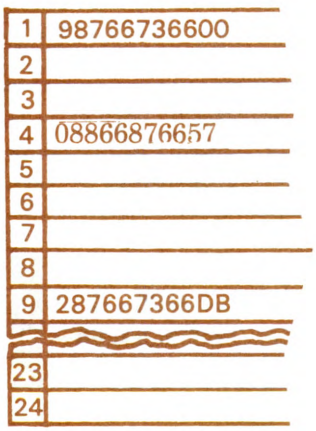
b. Dotted line shows "strap-thru" circuit from 151 Arty to COMCEN.

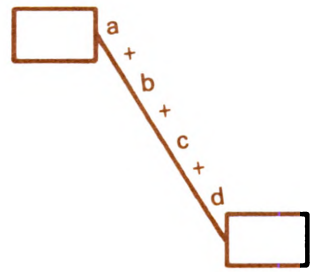
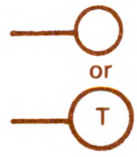
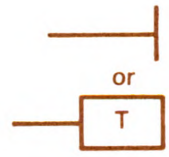
39	Spare.		

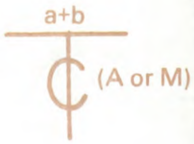
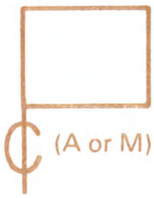
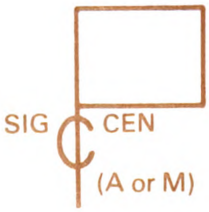
SERIAL WIRE:	EXPLANATION OF SYMBOL	SYMBOL U.S.	SYMBOL STANAG
40	Two-wire circuit, duplex transmissions.		
41	Four-wire circuit.	same	
42	Electrical connection between wires or cables.		same
43	Cables or wires crossing on diagram but not connecting.		same
44	Field wire line on ground, U.S. numeral indicates number of field wire pairs; STANAG: numeral indicates number of quads. One quad = 2 pair.	8FW	4Q
45	Field wire and cable on ground, U.S.: number of field wire pairs and coaxial cables; STANAG: two ground cables, each containing 8 pairs laid up as 4 quads and 4 coaxial tubes.	16FW 4(coax)	2x(4Q+4C)
46	Underground or submarine wire or cable.		same
47	Overhead wire or cable.		same

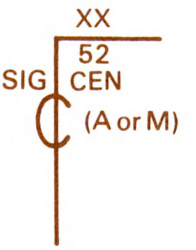
SERIAL	EXPLANATION OF SYMBOL	SYMBOL U.S.	SYMBOL STANAG
48	Cable on ground. U.S.: Number and type indicated above symbol (e.g. type: coaxial, SP4, etc); STANAG: three quad cables.		
49	Loaded cable (lumped loading). Example shows a 14 pr cable (laid up in quads) with first 10 pairs only loaded with 6mH coils spaced at 400 meter intervals.		
50	Field wire line spliced into another.		
51	Two field wires joining together (not spliced).		
52	General symbol for terminal equipment.	same	
53	Cable junction box.		
54	Cable test point (pair numbers 8-14 inclusive are terminated on the test box).		

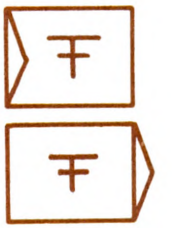
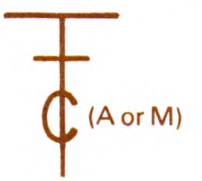
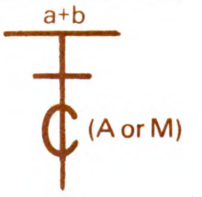
SERIAL	EXPLANATION OF SYMBOL	SYMBOL U.S.	SYMBOL STANAG
55	High voltage cables (Overhead assumed).		
56	Physical earth connection.		same
57	Attended repeater.		
58	Unattended repeater.		same
59	Amplifier.		same
60	Regenerative repeater ("Tg" or "D" for telegraph or data).		
61	Duplex telegraph repeater.		
62	Duplex telegraph circuit with regeneration in one direction only.		

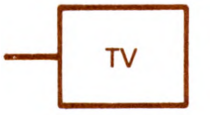
SERIAL	EXPLANATION OF SYMBOL	SYMBOL U.S.	SYMBOL STANAG
63	Converter		
	a. Voice frequency signaling unit where the two figures indicate 500Hz line tone and 20Hz ringing frequency.		
	b. Voice frequency signaling unit transmitting 500Hz tone chopped at 17Hz on receipt of 17Hz ringing signal.		
	c. Voice frequency tone dialing unit.		
64	Multiplexing equipment:		
	a. STANAG: 12 traffic channels, 1 service channel and 4 wire connection to the multiplexed input/output.		
	b. U.S.: 24 channel carrier system with sample circuit number designations on channels 1, 4, and 9.		

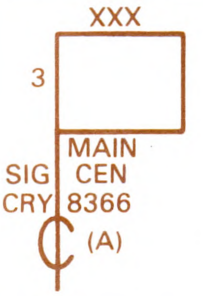
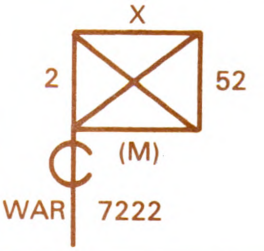
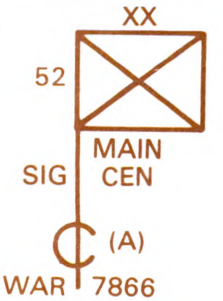
SERIAL	EXPLANATION OF SYMBOL	SYMBOL U.S.	SYMBOL STANAG
65	Facsimile instrument. (Also see #81)		same
66	On-line cryptographic machine.		
67	General method of showing what communications facilities exist between two locations: "a." = speech circuits "b" = telegraph circuits "c" = facsimile circuits "d" = data circuits		
68	Spare		
TELEPHONE:			
69	Telephone instrument.		
70	Telephone concentrator. (An instrument that permits several local subscribers to be connected to a SWBD via a smaller number of exchange lines. Subs would be connected only when originating or receiving a call.)		

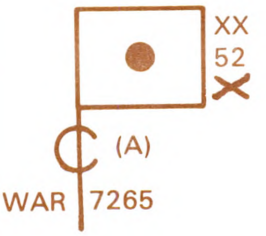
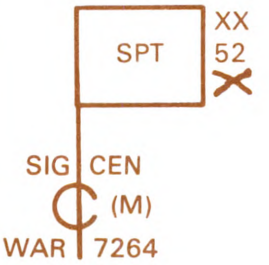
SERIAL	EXPLANATION OF SYMBOL	SYMBOL U.S.	SYMBOL STANAG
71	Telephone test point.		
72	Telephone center or telephone switching central not at a headquarters or HQ echelon. An "A" or "M" indicates automatic or manual switching capability. STANAG: The "a" and "b" indicate the maximum number of trunks and local circuits respectively.		
73	Telephone switching central at a headquarters or HQ echelon. An "A" or "M" indicates automatic or manual switching capability.		
74	A telephone exchange installed in a container body.		
75	Circuit or system ground.		
	SIGNAL CENTERS		
76	Command signal center. The "C" and "A" or "M" will be added to indicate the use of either an automatic or manual telephone switch.		

SERIAL	EXPLANATION OF SYMBOL	SYMBOL U.S.	SYMBOL STANAG
77	Area signal center not at a command post or headquarters. Size of unit is placed over the symbol. The unit's number is on the right of the staff and the "C" and "A" or "M" will be added to indicate the use of either an automatic or manual telephone switch.		
78	Signal center (Type not specified).		
79	Message center (Type not specified).		
80	Spare		
	TELETYPEWRITER and FACSIMILE:		
81	Teletypewriter (TTY), page printing, manual, operating half-duplex, Note: Change the doubtle 'T' to the letter 'F' to indicate facsimile equipment on numbers 81, 82, 83, & 89.		
82	TTY, page printing, manual operating full-duplex.		

SERIAL	EXPLANATION OF SYMBOL	SYMBOL U.S.	SYMBOL STANAG
83	a. TTY, page printing, receive only. b. Transmit only.		
84	TTY, tape printing, receive only.		
	TTY, tape printing, operating half-duplex.		
86	TTY, tape printing, operating full-duplex.		
87	TTY, tape transmitting only.		
88	Teleprinter or teletypewriter		
89	Teletypewriter switching center. The "A" or "M" designates either automatic or manual operation and the "a" + "b" indicates the maximum trunk and local circuits connected to the switch.		

SERIAL	EXPLANATION OF SYMBOL	SYMBOL U.S.	SYMBOL STANAG
90	Telegraph traffic retransmission centers. The "A" indicates a computer controlled store and forward relay and the "M" shows it is a manual tape relay center.		
91	Spare		
	AUDIO-VISUAL		
92	Television.		
93	Visual station		
94	Spare.		
	AUTOMATIC DATA PROCESSING SYSTEM:		
95	Automatic Data Processing Center.		
96	Computer		

SERIAL	EXPLANATION OF SYMBOL	SYMBOL U.S.	SYMBOL STANAG
97	Data terminal (Type: e.g. cards, papertape, mag tape, etc).		
98	Spare		
99	Command signal center, 3d Corps MAIN, identified by its communications designator.		
100	52d Infantry Division area signal center identified by its communications designator.		
101	Telephone switching central at 2d Brigade Headquarters, 52d Infantry Division, identifed by its communications desigantor.		
102	Command signal center at 52d Infantry Division MAIN identified by its communications designator.		

SERIAL	EXPLANATION OF SYMBOL	SYMBOL U.S.	SYMBOL STANAG
103	Telephone switching central at 52d Infantry Division Artillery.		
104	Command signal center at 52d Infantry Division Support Command identified by its communications designator.		

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30 SEPTEMBER 1976

By Order of the Secretary of the Army:

FRED C. WEYAND
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Chief of Staff

Official:

PAUL T. SMITH
Major General, United States Army
The Adjutant General

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